THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
The System of Supply at Liverpool	545
Electro-culture	546
Central Electric Light Stations:—Hull Corporation Supply (*illus*)	549
The Lady Electricians' Union Holds an Important Meeting	552
Underground Cables in India (*illustrated*)	553
Rental *v.* Telephonemeter (*illustrated*)	553
On Lightning Rods	554
Starting of Synchronous Alternators (*illustrated*)	555
Note on Life of Incandescent Lamps	556
The Lamp Situation in America	556
Facts and Figures on Electrolytic Chlorine and Soda (*continued*)	556
Telegraphic Communication in the West Indies (*continued*)	558
Electrical Pumping Plant	560
Improvement in Boilers (*illustrated*)	561
Legal	561
Reviews	562
Notes	564
Contracts Open and Closed.—Business Notices, &c.	568
City Notes, &c.:—Western and Brazilian Telegraph Company	569
Elmore's French Patent Depositing Company	569
Woodhouse and Rawson United	569
West India and Panama Telegraph Company	569
Traffic Receipts	569
Share List of Electrical Companies	570
Some Notes on the Design of Series Motors for Traction (*illus.*)	571
Electricity and National Economy	573
New Patents.—Abstracts of Published Specifications	574
Correspondence:—Modern Gas and Oil Engines	574
Cutting Down Prices	575
Parks Modification of a Wheatstone Bridge	575
The Attractive Properties of a Current	575
Relative Safety or Danger of Electric Light Current	575
A Strange Phenomenon.—Railway Train Lighting	576
Notes on Electro-Tanning	576

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THE SYSTEM OF SUPPLY AT LIVERPOOL.

WHEN discussing the use of the two-wire system in vogue at Brighton and Bradford, we referred in our last issue to Liverpool, where alone of all the large companies the local supply company have gone in for the simple two wires.

Mr. Bromley Holmes, who is well known as the chief and moving spirit of that enterprise, has informed us that in his opinion some of the remarks were calculated to convey a wrong impression as to the Liverpool mains. Now the system at Liverpool has seen vicissitudes which have not been the lot of the two mentioned at the same time. It dates back probably to the first large attempt to lay conductors underground.

Mr. Holmes agrees with us that the extensions are being carried out with three conductors, but these outlying districts at present have only a small demand, and the mains are therefore simply used in parallel with the two-wire mains.

In the future, when the demand increases, they will be supplied by the three conductors connected as a three-wire system. The most important point, however, upon which we touched, refers to the system to be used for lighting an ordidinary scheduled area, and on this point our correspondent is a most valuable ally, while at the same time an often-forgotten point is impressed upon us.

"The three-wire system is not yet in use in Liverpool, but the most important portion of the City is supplied from three generating stations, and as the distances are not great, the two-wire system meets the requirements of the case, and will continue to do so." That is to say, our contention is fully and amply borne out as to two and three wires for distributing, so far as economy is concerned. It is stated that no conversion has taken place from two to three wires; if not, certainly heavier mains have been laid to assist those previously in use. It is not possible to say all *pro* and *con.* on the subject, which was briefly put in our leader, but it is apparent that three stations are required even where the distances are not great, if two wires are to give satisfactory supply.

Of course, it is easily seen that local circumstances may, and in the case of Liverpool probably have, rendered it more economical in running, and in capital invested in mains, to lay down several stations rather than allow the feeders to become disproportionate to other items of capital expenditure, but this seems to be due to the system of supply adopted. The question of sites to a large extent determines this former question. These matters were referred to in our New Year's number, when describing "The System of Lighting" in Liverpool.

Mr. Holmes further credits the Liverpool Corporation with the recognition of the moral to which we called attention, but he unfortunately omits the words "for extensions." Inserting these, and noticing that Mr. Holmes himself is

extending on the three-wire principle, we cordially agree with him in this matter also!

"Whatever may be the merits or demerits of our method of working, Mr. Shoolbred must be absolved from any responsibility in the matter, as the Liverpool Corporation have not exercised any pressure on our company in favour of any particular system." It was always generally understood that the Liverpool Corporation had exercised considerable control over the company's arrangements, but we are glad to find that this was not carried out unduly, or to the extent of interference with the proposals and designs of the legitimate head of the enterprise, who, after the general welfare of the public collectively, had most at stake in this matter.

While admitting the importance of what Mr. Holmes has been good enough to tell us as to his own particular work, we think that the general principles with which we dealt have been sufficiently demonstrated by passing events to give weight to their bearing upon schemes at present in the incipient stage.

ELECTRO-CULTURE.

It is hardly fair to criticise electro-culture on the same lines as we might arraign a less embryonic science, although we may legitimately indicate the true direction in which researches should be directed, and, if needs be, object to the methods by means of which the pioneers of this new department of electricity carry on their investigations. The best attitude to preserve is probably that of the "open mind." At the same time, it is desirable that the ardour of enthusiasts should be tempered, at least in so far as regards their statements of possibilities; no one would desire to curb their experimental activity. It must not be assumed that electro-culture is going to render enormous services to agriculture; but we may recognise every result which tends to show that electricity is beneficial to vegetation, and when a vast number of authentic data have been accumulated it will then be time to generalise.

Those who are interested in this subject will find a carefully prepared review of the results hitherto achieved in the *Journal d'Agriculture Pratique*, 1893, Vol. i., No. 14, April 6th, pages 483—486, by Camille Pabst. The author is sufficiently enthusiastic to state that, in his opinion, this new science only awaits a favourable opportunity to render great service to agriculturists, although it cannot be said to have been brought within the scope of ordinary farming. His review is divided into two parts. In the first, he considers the effect of the electric light upon the growth of plants. He refers especially to the experimental work of Mons. Bonnier, who found that whilst some kinds of plants do not thrive under the influence of electric illumination, other kinds flourish, and, in fact, show every sign of stimulated growth. Other experiments are cited to show that where daylight is supplemented by the electric light at night, a beneficial effect is produced the development of the plant itself being greatly accelerated, whilst the flowers are more richly coloured and the leaves greener than those grown under ordinary conditions.

The second part of this interesting paper is devoted to a consideration of the effects of atmospheric and terrestrial currents of electricity when applied in agriculture. He points out that extraordinary natural electrification, such as exists during thunderstorms, produce nitrates and nitrites from the nitrogen of the atmosphere, which must fall upon the soil with the rain or in the form of microscopic crystal; in either event the results are beneficial, for these substances enrich the soil. The assumption conveyed is that like results can be produced artificially. Mons. Pabst appears to think that Baudoin's plan for producing rain by means of electricity may be beneficially applied with this result. To this scheme practical agriculturists will, we fear, probably say: "What is the advantage, since nitrates and nitrites can already be produced economically, and are found abundantly in terrestrial deposits, whence they can be removed and used in the cultivation of less fertile soil?"

Some observations made by Goiran and others are mentioned, to show that the germination of seeds and the growth of plants have been accelerated by earthquakes, which produce, he says, a great augmentation of atmospheric electricity over the locality in which they occur, and the experiments of Lagrange are cited, who, with Specknew and others, has demonstrated the beneficial action of currents generated in the soil. But although Mons. Pabst is a little too sanguine in his anticipations of the future of electro-culture, his paper may be commended, because the suggestions and anticipations are based only upon well authenticated experimental results, and not upon the vapourings of faddists.

New University for London.

A scheme is on foot for an extension of the London University; the object being the organisation and improvement of the higher education in London by a wider distribution of the present educational means in the Metropolis. To this are added various suggestions for the promotion of research and the general advancement of science and learning. For the purposes of the initial formation of the university, it is proposed to bring into connection with the present University of London such educational centres as Bedford College, Central Institution of the City and Guilds Institute, Gresham College, King's College, Royal College of Science, &c. The scheme, which will be found more fully detailed in the *Times* for April 3rd, has already been placed before the University Commissioners, and it has been adopted *nem con* by the Association for Promoting a Professorial University for London. At its present stage it is impossible to predict whether such a radical change in the university system is advisable. Its objects are high and the means are strong, there is, therefore, every reason to expect that good will come in the long run. The traditions which hang about the word "university" give a certain stimulus to those connected with them, which urges them to excel past records, and at the same time to keep sacred the old historic customs. Such antiquities are of service in so far as they excite men to work, but it would be unwise to let them hinder useful developments. The word "university" is taking a truer meaning as it extends. There is no reason to suppose that its dignity will lessen, though its condescensions should fall even to the level of the school itself. That its limits are widening is in no way a matter of mere patronage on the part of the universities, and certainly it is not a mark of their depreciation; rather it shows the improvement in the methods of lesser colleges and schools, and the increasing desire felt by all classes for the more recondite studies. So far then we are glad to have before us

a scheme for the extension of higher education. With the broad principle no one can find the slightest cause for disfavour. The particular form it will take, and the further discussion of details must, for the present, stand in abeyance.

The "Bonus" Principle Applied to Electricity Works.

THE absurdly remunerative prospects which electricity supply as a business possessed in the hands of financial and company men rapidly disappeared on the advent of the engineer. Economic laws do not cease to exist because physical laws happen to be those most prominent in connection with the industry, and this must be borne in mind by the technical as well as the business heads of supply companies. The most the business man can do at the formation of a company is to refrain from handicapping its chances by unwise financial arrangements. Afterwards he can get business and see that the truest trade principles rule in all transactions. It is, however, the engineer who holds under his control the making or marring of success. The capital invested is large proportionately to the annual revenue produced, and the utmost economy in engine room stores is essential to commercial success. With this end in view several companies have declared themselves upholders of a bonus system whereby the operative or employé becomes a shareholder in such economics as may be due to his efforts. The heaviest item of the central station's expenditure being coal, that article being at all times liable to fluctuation in price, which in London is always high, and being the one thing which by carelessness or want of skill it is the most easy to squander, it is not surprising that the company with the lowest coal poundage per unit is that which makes this matter one of pecuniary interest to those in whose hands saving in this direction is possible. The Westminster Company at present estimate their engine room expenses at £4 13s. per 1,000 units generated, and, with a view to reduce such expenses, offer a bonus to their workmen of 10 per cent. of the difference between this figure and that which is actually the cost of production of this quantity of electrical energy. This principle is capable of considerable extension in the domain of the electrical industry, and, judging from its operation as an economic factor in purely trading circles, one would look for a like success in its application to electricity works, and others of a like nature. To effect its purpose the utmost fairness must be shown in applying such a system, and its advantages can only come in where the basis of costs from which a saving is computed can be reckoned with some degree of accuracy. When current outputs run up to numbers reaching close upon five figures of ampères it does not take much to influence cost, and therefore the profit one way or the other. Mr. Livesey, of the South Metropolitan Gas Company, several years ago introduced a similar profit-sharing system into the large works of his company, and the results were so satisfactory that many other large gas concerns have tentatively followed his lead, on the whole with advantage. The principle of profit-sharing has been successful beyond the most sanguine expectations in large co-operative schemes in the North of England, as well as in isolated cases elsewhere; there seems to be no reason to doubt that were it applied universally to concerns in the electrical industry it would benefit both employés and shareholders.

Hall's Phenomenon.

A SHORT time ago in noticing some researches bearing upon the well-known phenomenon of Hall, we expressed the hope that they would be followed up and the difficulties which are inherent to it fully explored. We are glad to see that Prof. Kundt, the President of the Physical Society of Berlin, has undertaken this study in earnest. At a recent meeting of this society he gave a preliminary account of an investigation which he is at present carrying on, which, when concluded, will we trust set at rest all the discussions which the obscure phenomenon of Hall have given rise to. The so-called Hall's phenomenon is directly proportional to the intensity of the primary current, but inversely proportional to the pressure of the plates; but there are exceptions, it is not strictly proportional to the magnetising current in the case of certain of the metals. So far as Prof. Kundt's researches carry us there seems a probability that Hall's phenomenon will be found to be proportional to the magnetisation of the plates. The plan of investigation which is now being pursued by Prof. Kundt is to prepare translucent metallic films and to magnetise them, their magnetisation being then determined by observing their rotating power on polarised light, and in many instances he has observed that the Hall effect increases directly with the rotating power and therefore with the magnetisation of the plates.

Impedance.

ONE would have thought that the elementary consideration of this subject had been pretty well used up, but Mr. Kennelly has recently read a paper before the American Institute of Electrical Engineers which is a model of clearness and simplicity, and at the same time deals with some of the more difficult points of the subject. He coins the convenient terms "inductance-speed" and "capacity-speed" for the quantities $p\,l$ and $1/p\,\kappa$ in connection with sine currents acting on circuits with self-induction and capacity, and gives a set of very simple rules for the calculations required in most practical cases involved. Mr. Kennelly has also been attacking the problem of rectangular waves of the type often called "top-hat functions" from the analogy of their shape to that article of modern apparel. Some of his results are very interesting, although, of course, lacking in much practical importance.

Transformer Theory.

MESSRS. CREHORE & BEDELL are starting a series of articles on the transformer, following the same lines as their papers on alternating currents. Up to the present they contain nothing beyond the familiar academic ideas of self and mutual induction coefficients, with the accompanying imposing array of symbols, but doubtless as the subject expands in their hands many practical points will be very clearly put, and, in any case, we shall expect from these authors an exceptionally clear exposition of the present state of the subject.

Physical Science in Secondary Schools.

THERE is an evident desire in America, as well as in England, to mingle a little science with the more orthodox school studies; a modicum of physics with an allowance of Latin, and a dole of chemistry with the usual Greek. Apart from the practical usefulness of a knowledge of physical processes, the mental culture which is attained by their study is found, even to the younger scholars, to be valuable and lasting. This is sufficient proof that such instruction is of the right kind, well suited to develop good men. *Science*, of New York, contains an article devoted to this matter, written by Mr. Charles F. Mabery, Professor of Chemistry in the Case School of Applied Science, Cleveland, Ohio. The procuring of suitable teachers is the first difficulty, those possessed of an adequate knowledge, and, at the same time, sufficiently enthused with their subject to impart to their scholars the desire to learn. The expense of the necessary apparatus, and the extra rooms required as laboratories, is a grave hindrance in many schools; it is clear that progress must be rather slow, especially in the poorer districts. The estimates of cost, drawn up by Mr. Mabery, based upon his extended

experience in several laboratories, will be very valuable. His figures show that in a room 40 feet by 30 feet, 48 desks may be arranged with ample accommodation for 96 students, working in two divisions; or for 144 students, working in three divisions, leaving space enough for separate drawers and lockers, apparatus for each division, and all necessary hood-space and sinks. The cost of such a laboratory, including all gas-fitting and plumbing, re-agent bottles, &c., in fact fully equipped, except with apparatus for individual students, should be less than $1,500. The cost of apparatus needed by each student should not exceed $5. The cost per year of chemicals, and of apparatus to provide for breakage, should not exceed $6. A class of 25 students can be accommodated in a room 20 feet by 27 feet, and the expense of a complete equipment should not exceed $700. It is proposed to teach chemistry and physics in these laboratories; and the professor suggests that the same room will do for both subjects. Perhaps chemical re-agents are not so pernicious in Cleveland, Ohio, as they are in England; we cannot tell, but even if they are half as bad we have great pity and little hope for the budding physicists. If only one room is available it must of course be used alternately for chemistry and physics, but there are fearful evils attending these "Box and Cox" devices. Chemical fellows have such an air about them, a condemning *lotus* which no amount of diplomacy can fathom or dissipate. It is fatal to the physics instruments, it is fatal to the physics students, and considering that physical laboratories have already been threatened with obliteration by those intolerable electric railways, it will be doubly hard upon them if the subtle chemists should now seek to dissolve even the remains.

The Leclanché Cell.

There is an important contribution to our knowledge of the Leclanché cell in a paper by A. Ditte which was presented by Mons. Froost to the Paris Academy of Science on April 17th (*vide Comptes Rendus*, Vol. cxvi., No. 16, p. 812—815). The author examined the behaviour of an element consisting of a rod of zinc attached to a plate of platinum and immersed in a 10 per cent. solution of common salt. In course of time it was observed that the zinc became covered, as regards its upper part, with a layer of zinc oxide, which appeared to descend along the rod and then to spread out in a horizontal direction, thus separating the liquid into two layers, the upper portion of which was of an alkaline character, and entirely free from zinc, whilst the lower stratum of liquid remained mutual and was found to contain chloride of zinc. Details are also given of the behaviour of a cadmium-platinum element, which presents very different results, the electrolysis of the salt taking place by a sort of exothermic action. Mons. Ditte proposes to lay the whole of his investigations, together with the conclusions he deduces, before the Academy in the form of a memoir.

The Coefficients of Fundamental Laws.

A paper by Mons. E. Mercadier, of broad theoretical interest, may be found in the *Comptes Rendus*, Vol. cxvi., No. 16, April 17th, pp. 800—803. It deals with the general relations which exist between the coefficients of the fundamental laws of electricity and magnetism. The author considers these laws in the order in which they have been discovered. Amongst the more important results, we note the following: The ratio of the coefficients in the electrostatic law of Coulomb and the law of Ampère represents the square of a speed. The ratio of the product of the two laws of Coulomb to the square of the coefficient of the law of Laplace represents the square of a speed. The coefficient of the law of Laplace is the mean proportional between the coefficients of the law of Ampère and of the magnetic law of Coulomb. In an ensuing communication to the Academy, Mons. Mercadier proposes to point out the general consequences which can be deduced from these propositions.

Dynamo-Electric Machinery with Compound Excitation.

The possibility of producing currents which, between certain limits, do not vary with the speed of the engine, has been practically realised by means of two separate exciting currents. The short paper in which Mons. Paul Hoho describes this result is of a mathematical character and may be consulted in the *Comptes Rendus*, Vol. cxvi., No. 15, April 10th, page 744. He states that if a curve be constructed showing how the magnetic excitation of a dynamo-electric machine ought to vary according to a given law it is possible to bring about such an excitation, that if this be also expressed in the graphic way as before, the two curves thus obtained may be made to intersect each other in any number of desired points. Between these points of intersection the two curves are almost coincident. The recognition of this property of dynamo-electric machines with compound excitation gives the direct solution of a practical question of the highest importance, viz.: the production of electric currents which are not subject to the influence of variation in speed, between certain limits, when the dynamos are driven by engines of irregular speed. In realising this by compounding, the two separate exciting currents are supplied either by two small exciting dynamos, or by the machine itself and a small exciting dynamo, or by any other convenient source of electricity.

Country Roads and Electricity.

One branch, at least, of electrical engineering must be in a particularly flourishing condition in the United States, if the *Scientific American* be accurately informed. We read in the issue for April 15th the following: "At present the electrical manufacturers are over-burdened in filling orders for street railways, and they are compelled continually to enlarge their plant to meet the demand. But in the course of a few years, four or five at the utmost, the urban and suburban demand will be pretty generally met, and the orders will begin to fail; then we can look to see the next step taken." The writer of the article in which this occurs considers that it would not be consistent with the character of the American manufacturer to abandon a portion of his plant "when the whole continent remains to conquer." He will push into new fields and invade the country. The country stage coach has gone—the country road must follow. The "next step" is to lay electric railways on all the country roads, and through the general distribution of power to enable the farmers not only to travel wherever they please, to go at any rate of speed that they are willing to risk, in vehicles under their own private control, but to do a large part of their farm labour by electrically propelled agricultural implements. America is, we know, a country of magnificent distances and difficult means of inter-communication are inevitable, but these difficulties will disappear, it is claimed, on the advent of the electric locomotive which "has a wonderful facilty for running up and down hill, and which requires, therefore, little or no grading." The writer of the article in the *Scientific American* is either "beating the air" or he is speaking with authority and representing a group of capitalists. When he enters into an elaborate analysis of the advantages which will accrue to the whole country side when electric traction is universally adopted, and goes so far as canvass such eventualities as the consolidation of the churches, the unification of schools, the flight of monotony and dullness, the advent of popular entertainments, the engendering of a more cosmopolitan spirit, &c., we are disposed to regard him as a hysterical enthusiast. But when, however, he asserts that electrical railroads are believed to be the best field of investment yet remaining in the United States and "too promising to be neglected, even should not the farmers themselves become the promoters," he is descending from his "high falutin" to the range of practical matters. Americans are plucky enough to attack even such a vast problem as the extension of their electrical street railroads to the rural districts, but whenever a company is formed to attempt this, even on a small scale, we should not advise that the writer of the article in the *Scientific American* on "Electricity and Country Roads," be elected to the chairmanship."

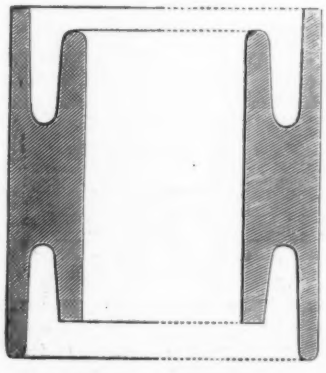
CENTRAL ELECTRIC LIGHT STATIONS.

No. 9.—HULL CORPORATION SUPPLY.

ON April 28th, 1891, a Committee of the Hull Town Council recommended that the Corporation should at once proceed to build a generating station for the public supply of electricity. Two months later these recommendations were adopted, a grant of £25,000 was made, and the work at once commenced, with the result that within 14 months later a very creditable central station has been completed to the designs and under the supervision of Mr. F. Harman Lewis, the Borough electrical engineer.

THE STATION.

The station is built on the site of an old warehouse in Dagger Lane, near Princes Dock. The building will permit of extensions, when necessary, at very little extra cost. No little difficulty has been met with, both in the erecting work and the laying of mains, for the soil in the town consists of a stiff stratum of clay of about 7 to 10 feet thick, under which, to a depth of 60 or 100 feet, there is nothing but a watery silt. Owing to this it has been necessary to build the chimney, which is 105 feet high, on 25 12-inch piles, 25 feet long, the engine and boiler concrete foundations being treated in a similar way. The station can be entered from streets at either end and at the engine room entrance, rullies can be backed into position underneath the travelling crane, enabling loads to thus be quickly and easily taken off. The engine room is 48 feet long by 32 feet wide, and contains 4 Willans-Siemens sets, two for 150 volts and 300 ampères each, and two for 115 volts and 1,000 ampères each, foundations being provided for the addition of two more sets of the latter size. At the back of the row of engines, by the exhaust pipe, a pit is provided for a surface condenser, which will be erected as soon as terms can be made with the Dock Company for the use of water.



SECTION OF INSULATOR.

The length and width of the engine room is traversed by a 5-ton overhead crane, supplied by Messrs. James Spencer, of Hollinwood, Manchester. The boiler house is 72 feet long by 32 feet wide, and in it are set three Paxman economic boilers, 13 feet 9 inches long by 7 feet 6 inches diameter. Foundations and flues are already constructed for two more similar sized boilers to be added when required. The feed water is obtained from the town supply, and being very hard, is softened by lime before it enters the feed tank.

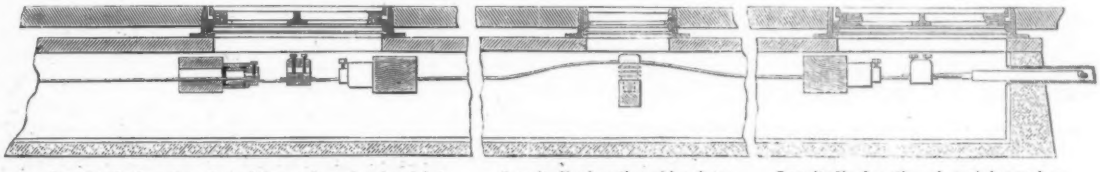
ACCUMULATORS.

Over the boiler house is the battery room, which contains a double battery of 120 31-plate Crompton-Howell cells, with room for as many more. These accumulators are intended to give in a sudden emergency a maximum discharge of 250 ampères from each battery, but they give their best working results at a discharge of about 100 ampères. In case of a sudden demand, about 2,000 8-C.P. lamps could be supplied for short periods, or about 650 lamps could be supplied throughout the night. The whole of the connections are of solid copper protected from the action of the acid spray by patent enamel.

A similar pair of batteries to these at one of the stations belonging to the Westminster Company in London, has on more than one occasion supplied a sudden demand nearly 100 per cent. greater than the maximum above given, without the plates being injured in any way.

We are informed that the maintenance of this type of battery has in practice been found not to exceed 2 per cent. per annum during the first three years of working.

The offices have a separate entrance from the street, and are over the engine room. They consist of chief engineer's office, clerk's and enquiry office, testing and assistant engineer's room, lavatory, &c.



Longitudinal section of straining-up box, showing joint of two strips.

Longitudinal section of insulator box.

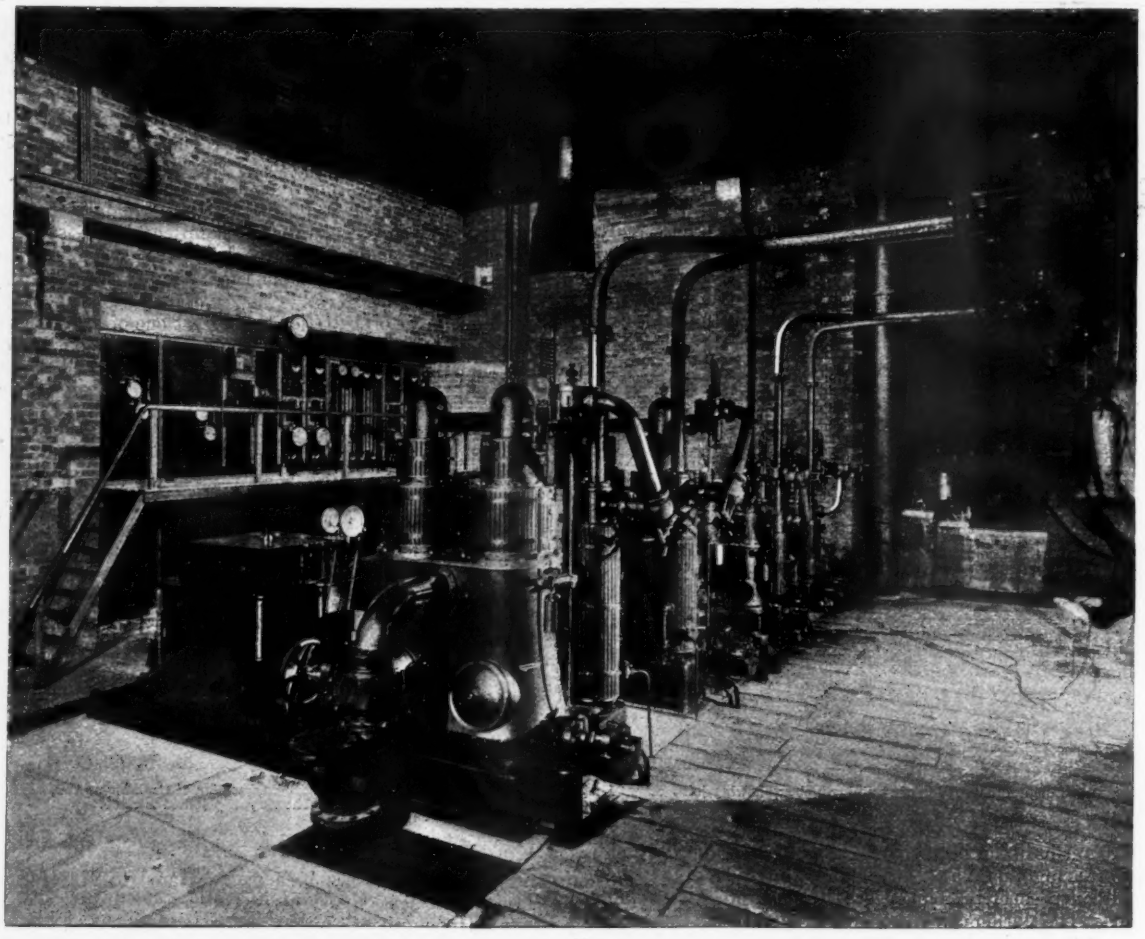
Longitudinal section of straining-up box, showing strip joined to cable.

THE SWITCHBOARD.

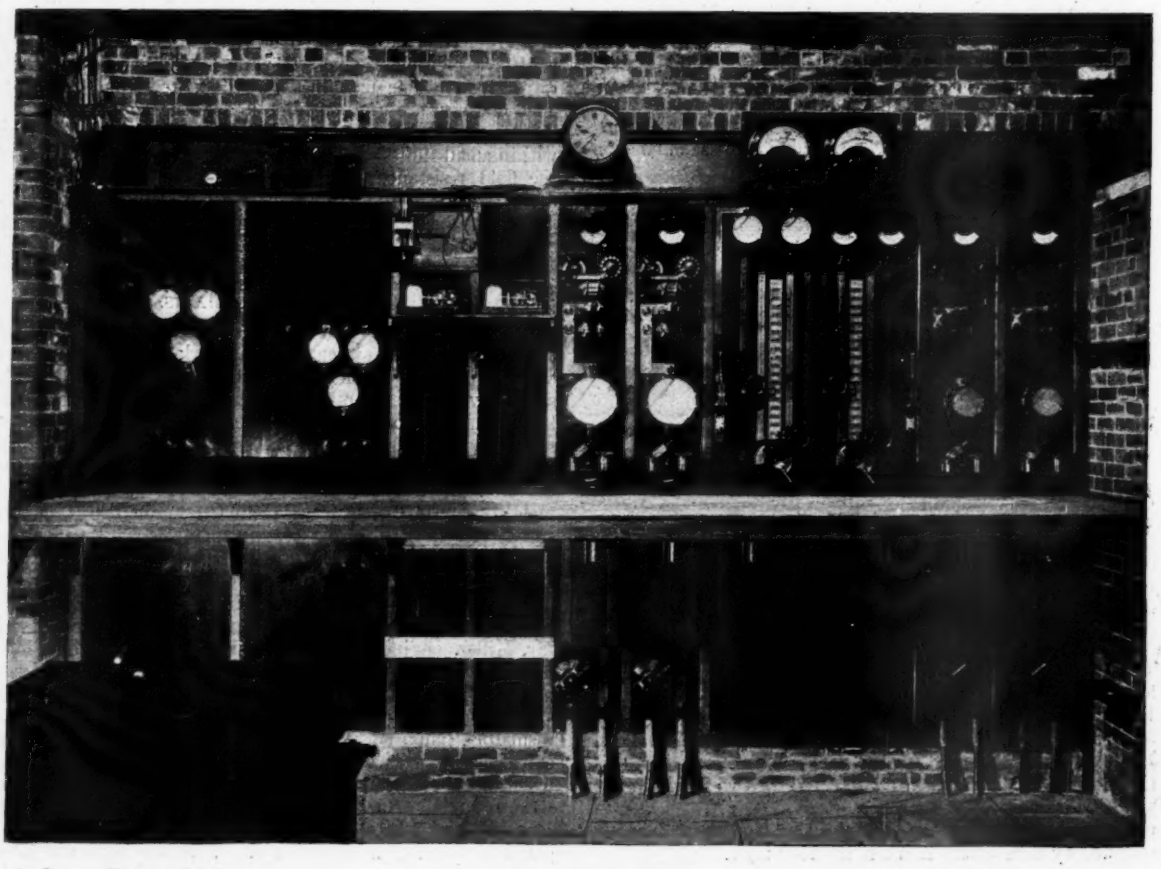
The switchboard has been manufactured to Mr. Harman Lewis's specification and general design, by Messrs Siemens Bros. Upon it there is a slate panel, 16 inches wide, for each machine, and other panels for the batteries and feeders. The terminals of any one machine are brought to the base of its corresponding panel, where one of the terminals is connected by a switch to the neutral wire. The other terminal is connected to either positive or negative omnibus bar through a watt meter, automatic cut-out, ammeter, and two-way switch respectively. The machines are self-excited from the board. The engines are run entirely under the control of their governors, regulation being effected by a lever for adjusting within small limits the governor valve, and by variation of the field resistance. The works were formally opened on January 16th of this year, since when the outdoor staff has been continually busy connecting up consumers, of which there are now forty-seven, representing about 4,500 8-C.P. lamps connected.

THE SYSTEM OF MAINS.

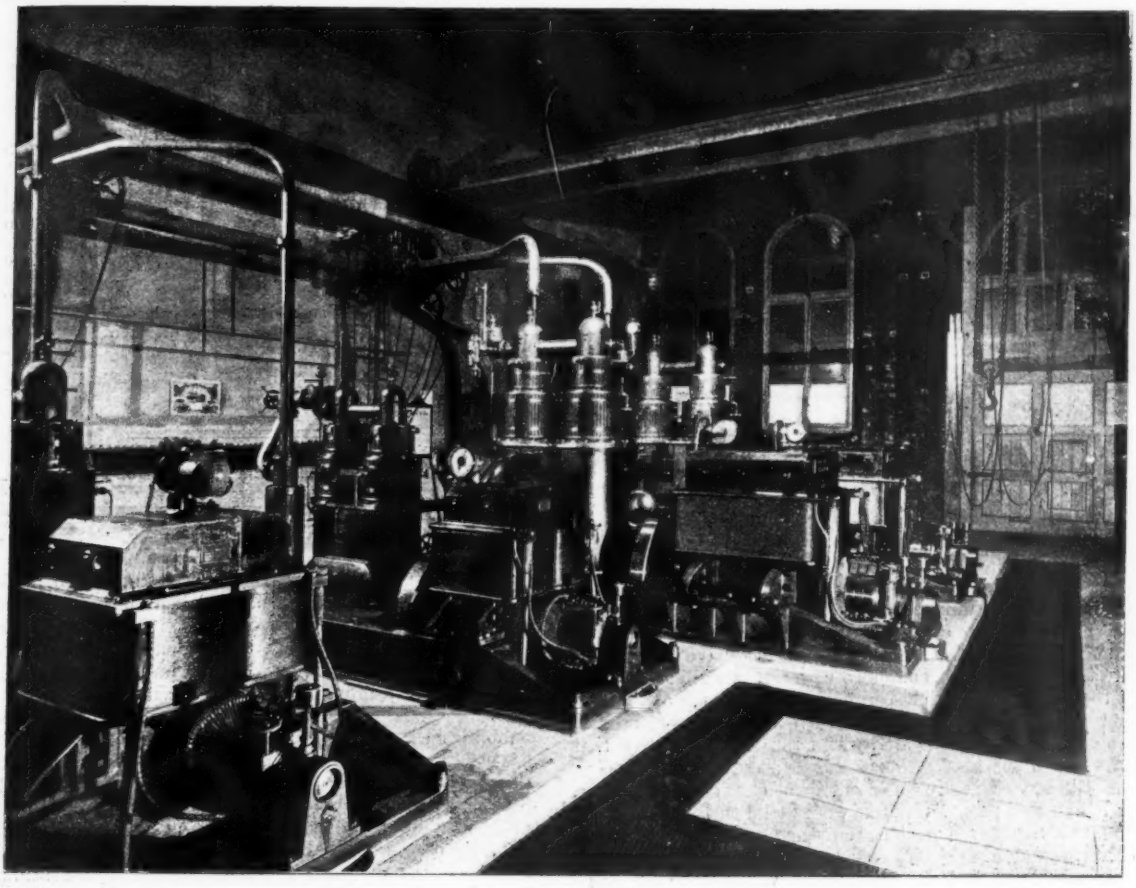
The mains are about 2½ miles in extent, and are laid on the three-wire system, the network being fed at six different points, at a pressure of 220 volts on outside wires, giving consumers the current at 110 volts. They are laid upon the Crompton culvert and bare copper conductor method, vulcanised rubber cables, drawn into iron pipes, being substituted where it was found impracticable to lay the culverts. The copper strips are not held in position by gun-metal bridge pieces, as is usual in Crompton mains, but by comparatively small blocks of gun metal, which are clamped on to them, and, which, by resting against the inner lips of tubular insulators of the section shown by the fig., prevents the strips from slipping back on to the floor of the culvert. This form of insulator was designed and patented by Mr. Miller, engineer to the Kensington and Knightsbridge Electric Light Company, where it is used on several hundreds of yards of main. The insulator has many good points, and is surprisingly strong. The chief advantage of employing tubular insulators, independently of their particular shape, is that the copper conductors are held nearer the roofs of the culverts, which enables one with a given depth of culvert to place the straining points further apart, or with given positions of the straining points to make the culverts shallower. The corrugated supporting insulators, used at the service boxes, have



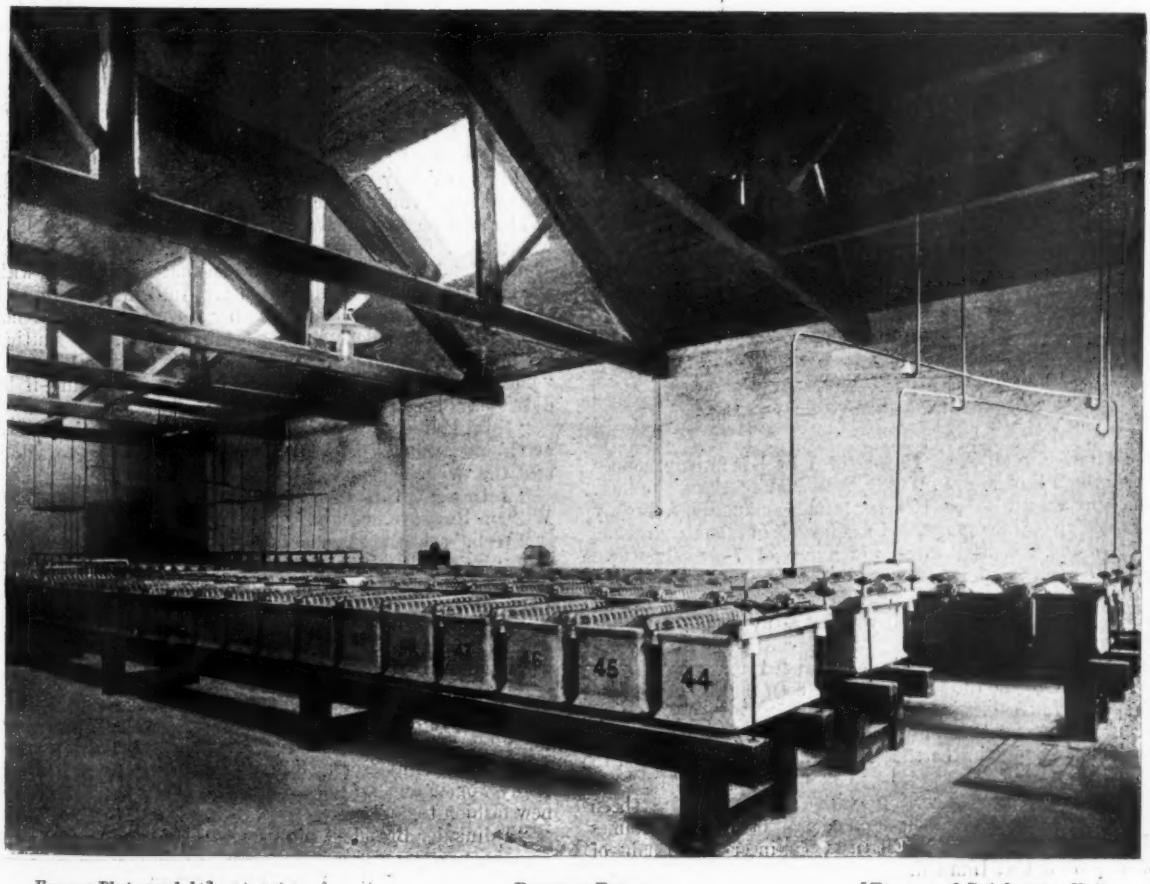
From a Photograph by] VIEW OF ENGINES. *[Turner and Drinkwater, Hull.*



From a Photograph by] SWITCHBOARD. *[Turner and Drinkwater, Hull.*

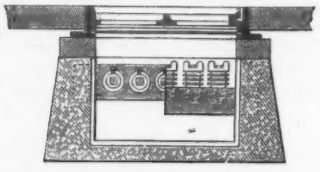


From a Photograph by] VIEW OF DYNAMOS. *[Turner and Drinkwater, Hull.*



From a Photograph by] BATTERY ROOM. *[Turner and Drinkwater, Hull.*

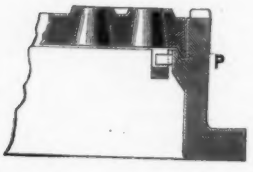
been made of glazed porcelain instead of glass, as being less brittle, and of superior insulating qualities. The gas pipes being laid under the foot pavements, the culverts for considerable distances are unavoidably laid close alongside them, and judging by the appearance of some of the excavated soil, it was deemed advisable to adopt some means of keeping the culverts well ventilated. It was somewhat difficult to hit upon a method against which no objections could be urged, but, ultimately, Mr. Lewis designed and adopted an arrangement, which consisted of sinking in the ground at the



Cross-section of straining-up box; cross-section of insulator box.

ends of each clear length of culvert, and connecting to the culvert by a 4-inch sanitary pipe, an ordinary stoneware gulley, from which the trap web, P, had been knocked away, and placing upon it a perforated cover plate, as shown in the drawing. The gullies are placed close against the walls of the nearest houses or shops, so as to obtain the sheltering from rain which the overhanging cornices and shopboards effect. This position, combined with the special construction of the cover plate, which permits a ¼-inch depth of water to flow gently over it without falling through the perforations, practically keeps out water, whilst the small quantity that does get in together with the dirt collects at the bottom of the gullies, which are cleaned out about once in three months. It is said that these ventilators work better than was expected, and that there is a decided movement of air through the culverts which are very much freer from the smell of dead gas than they were before the ventilators were fixed. The ground in which the culverts are laid was found in many cases to be simply saturated with gas which had apparently escaped from the gas mains.

Section of ordinary stoneware gulley. The web, P, to be removed.



Section of culvert ventilator cover P, packing.

There are in all about 15 tons of 1 by ¼-inch bare copper tape, which is of Messrs. Wilkes, Sons & Mapplebeck's rolling, and guaranteed to be 100 per cent. conductivity, already strained up in the culverts, and 4,500 yards of Silvertown cable, besides the potential wires which are of 7-20 Silvertown class L. These are led from each feeding point through the culverts and pipes to the switchboard in the usual way, and are of a total length of 8,000 yards. To avoid the tube ends cutting or abrading the insulation of the cables as they are being drawn in, wrought-iron expanded ends have been screwed on to the tubes; these have been found very useful in protecting cables when drawing in. The cable has all been so arranged that only two joints have been made over the whole system in the tubes, and these were vulcanised in the proper way.

The work in connection with the mains has been carried out under the superintendence of Mr. B. Holmes Jenkinson, A.M.I.E.E., F.I.Inst., engineer on behalf of Crompton & Co., Limited.

COST OF GENERATING STATION AND MAINS.

	£	s.	d.
Three boilers, including setting...	1,692	4	5
Four dynamos	2,430	0	0
Four engines	2,379	0	0
Steam, exhaust, water and drain pipes, pumps, injectors and tank	800	0	0
4,500 yards mains	10,054	1	5
123 accumulators erected on stands	1,494	6	0
5-ton overhead crane	110	0	0
Switchboard	633	0	0
Cable connections from machines through switchboard to mains	165	0	0
Water softener	120	0	0
Buildings	3,020	0	0
Electric lighting of station and steam pipe lagging	100	0	0
Testing instruments, &c.	75	0	0
Total	23,072	11	10

THE LADY ELECTRICIANS' UNION HOLDS AN IMPORTANT MEETING.*

LOVELY woman is becoming so rapidly emancipated, and has won her way into so many fields of labour hitherto occupied exclusively by men, that the formation of the Lady Electricians' Union, of New York City, has not received that mention in the public Press which its importance warrants.

The idea of a protective and beneficent society composed of the leading lady electricians of the metropolis has been bubbling in the brains of a few women for some months, and has at last come to fruition. The Union was organised at the dress goods bargain counter at Macy's a week ago last Saturday, by four lady electricians, who experienced a magnetic attraction induced by reading advertisements in Friday's papers. The organisation was perfected on the impulse of the moment, and officers were elected at once. The Union has not, as yet, adopted a constitution and bye-laws, but they will come in the course of time.

The first business meeting of the Lady Electricians' Union was held last Saturday evening, the members following the example of the opposite sex, and choosing Saturday evening, so as to have Sunday to recover their normal status.

Mrs. Delia Lafferty, proprietor of the "Venus" electric corset and President of the Union, called the meeting to order and said :—

"Lady Electricians: Oi notice in the back part av the room, behoind th' shtove, what looks loike a loive man. Oi'll foine th' lady who brung 'im here twinty dollars, anless he is removed this minute. An' Oi've said and troth to it."

The reporter for the *Electrical Review*, at whom this sally was aimed, felt compelled to protect his hostess of the evening, and came forward to explain that he floated in with the tide, that he had no ulterior motive in being present, and that he would remain behind the big stove and promise not to look if the President would let him stay. After putting the question to vote it was decided that if the reporter would "put their names in the paper" he might remain—if he didn't use his eyes too much.

"Now, ladies," said President Lafferty, "havin' disposed av th' men, we will proceed to business. I desoire to shtate that the 'Venus' electric corset——"

"I thought this was a protective union," began Mrs. William Ramsaye, meekly.

"Well," said the President, "if the 'Venus' corset ain't protective, Oi'll ate two av thim."

This unanswerable logic gained the floor for President Lafferty, who then proceeded as follows :—

"As I wuz sayin', the 'Venus' electric corset is a great deloight to fiminine hearts. (Applause.) An', besides, the current which chases around yure waist and up an' down yure spine afther you have put it on constitutes a counter electromotive foorce which will be found valuable to counteract anny ill effects ye may get from wearing crinolean shkirts under an electric loight. An' Oi hope yez all are hardy women and will wear crinolean shkirts, as it is the new fashion to do."

"I dink der Bresident bin using dis sociedy to make some

* New York *Electrical Review*.

sales alretty vonce, of her gorsets, by chimminy," remarked Mrs. Heinrich Weisenschnipper, whose claim to membership in the Union lies in the fact that her husband is a firemen in a big electric light station up in Harlem.

"Oi haven't th' anner av the lasht speaker's acquaintance," remarked President Lafferty, "but all th' same, Oi would loike to politely inform her that her remarks are very much out av order, and will not appear on th' minutes av this meetin'."

"Mrs. President," came in a high bass voice from a back row. The President, grateful for a change of subject, smilingly said :—

"Mrs. Ophelia Lanworthy has th' flure, ladies."

"Mrs. President and ladies," began the latest speaker. "I have noticed in my reading, lately, that some of our scientific papers are disputing the accuracy of the Rev. Mr. Ohm's law. For the benefit of some of our newer members, I will explain Ohm's law." This was said with a condescending glance at the audience. After adjusting a large silver hair-pin in her Psyche knot, Mrs. Lanworthy continued:

"In my exposition of this fundamental law of electrical science, I will assume a concrete example as better adapted to the purposes of elementary instruction, ahem! This law, as you are all doubtless aware, states that the current is equal to the electromotive force divided by the resistance. Now, if I am using my Dr. Dewlap's electric hair brush, and my husband uses his electromotive force to make me desist, the current flowing from the brush to my hair will be proportional to the resistance I offer to his efforts. Or, to put it algebraically——"

"Mein Gott in Himmel! Vas ist los mit Lanworthy?" came from the direction of Mrs. Weisenschnipper. "It vas beer time, alretty quick, now, I'm dinkin'."

"Ladies," came in a masculine voice from behind the stove. "If you will permit me, I will be charmed to have some cold tea sent in from the corner sal—grocery, I mean."

"Motion seconded and carried unanimously," snapped President Lafferty. And as the *Reviewite* sneaked out to make his promise good, the hubbub sounded like a Fifth Avenue 5 o'clock tea.

VOLTABOUT.

UNDERGROUND CABLES IN INDIA.

THE Secretary of the Institution of Electrical Engineers has recently received from Mr. P. V. Luke, Calcutta, a photograph and description of a piece of cable which passed through a curious experience. The block below shows a piece of the India-rubber cable (Hooper's core) through which a root of grass has grown, and illustrates one of the dangers to which underground wires in India are subject. It came about in this way: The piece of

core in question, after being treated with a composition said to be a preservative against white ants, was buried, unprotected by any armour, in soft, damp soil at Calcutta for six months to see what happened. On the piece of core being dug up, the grass was found to have grown through it as described. What at first sight appears to be an impossible performance on the part of grass seems less so when it is stated that the roots of this species of grass are characterised by very hard, sharp, needle-like points.

RENTAL v. TELEPHONEMETER.

SOME two years ago, we argued in these columns the advisability of substituting a more fair and rational system of telephone rental for that then and still now in existence. At that time, we were inspired to such a course by the introduction of a new and ingenious contrivance put on the market by Messrs. Mix and Genest, Limited, of Berlin and London.

The idea that each subscriber should, instead of paying a yearly rental, be called upon to pay only a fixed charge when using the instrument, was too much and too great a departure from the established rules to find favour with the moving spirit of the various telephone companies, and the fate of the automatic call box was, that it was only adopted by two telephone companies in the East and South American dominions.

The stimulus of reforming the telephone rental could, however, not be retarded, and at the Electrical Congress at Frankfort-on-Main, in September, 1891, Dr. Strecker, chief inspector of the German Government telephone department, read an interesting paper (*vide Verhandlungen des Internationalen Electr. Congress*, Vol. ii., p. 289), in which he threw out the idea of *measuring* the telephonic conversation carried on by each individual subscriber, thus enabling the telephone companies to check the misuse by non-subscribers on the one hand, and to divide the burden of payment on the part of the subscriber, commensurately to the number and length of conversations indulged in.

It is obvious that such a system, which only asks a subscriber to pay for services actually rendered by the telephone company is far more reasonable than that which charges indiscriminately a yearly rental, no matter whether the subscriber be a busy stockbroker, merchant, or fashionable draper, who is constantly ringing up the exchange, or a retired farmer, who only occasionally unhooks his receiver.

Dr. Strecker, in his able paper, describes an instrument which we may call a telephonemeter (*Gespraechs Zeitmesser*), the construction of which was that the clockwork of same registered the time of each conversation from the time of ringing up the exchange to the ringing off signal. On the basis of the principles set forth at that time, the German Government Telephone Department issued a programme for the construction of a telephonemeter that would allow the registration of each conversation from the time of unhooking of the receiver, to the replacement of same, so as to have an instrument to abolish a yearly rental, and to substitute a fixed rate according to the duration of the conversation. It will be seen that the principle of charging for telephonic conversation according to the time, which has been successfully introduced and practised on long distance lines, could and should be made more universal, if only a meter (which does not necessarily require to be approved of by the Board of Trade, as with electricity meters) could be made simple, reliable and accurate.

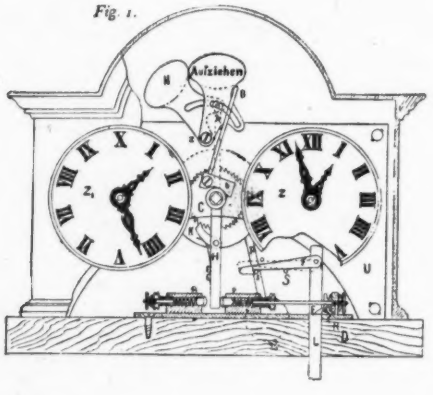
It is again due to the ingenuity of Messrs. Mix and Genest, Limited, whose leading position among telephone engineers is well known, that such a telephone time meter is now available, and we deem it expedient to describe and illustrate the telephonemeter that has been patented by the firm mentioned above.

The object of the telephonemeter is to control the duration of telephonic conversations and to total up same. It is intended to connect it to the telephone station, which latter is actuated by the former mechanically. It consists mainly of a clock or watch movement having a starting and stopping arrangement which is operated by unhooking the receiver from and replacing same to the automatic switch. Another point of importance is the use of the telephone instrument to be possible only when the clock is wound up, and also that it should be shown when the clock is running down.

To the automatic switch, A, fig 3, is connected a guide rod, L, the length of which can be regulated by a nut screwed both right and left hand thread at opposite ends, and which rod is protruding from the top, D, fig 1, of the telephone instrument, and penetrating into the clock case, U. On the free end of this rod is a movable arm, *f*, provided with a hook, which rests on a fixed pin, S. The head of this hook is so shaped that the pin, *s*, affixed to the pendulum, P, when the pendulum is swinging, lifts the hook and catches on to the latter's nose arresting the clockwork.

When the receiver is unhooked, the automatic switch, A, is pulled down by a spiral spring, and the back, or bell, contact switched on. This movement lowers the guide rod, L, with the latter portion of the hooked arm, *f*, the notched head of which is raised to the position indicated by dotted lines, thus releasing the pendulum and re-starting the clockwork. It will be seen that the hands of the clock will move so long as the receiver is unhooked, and will be stationary when the receiver is replaced. In order to obviate the reading of the dial, Z, to be taken too frequently, the meter may be provided with an additional dial, Z 1, the hands of which are moved by a suitable train of wheels, whereby it is possible to greatly multiply the hours registering the use of the instrument, and yet controlling the duration of each conversation. To switch off the instrument when the clockwork is not wound up, and to remind the subscriber of doing so, there is provided an indicator, N, which is worked in the following manner.

Fig. 1.



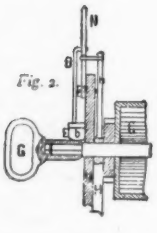


Fig. 2.

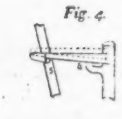


Fig. 4.

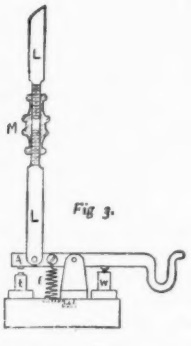


Fig 3.

The reduction of tension in the clock spring, C, is utilised to limit the movement of the automatic switch. The result is obtained by fixing the catch, K, not to a fixed pin, but to a movable lever, H, fig. 1, which moves on the pivot of the barrel itself, or on another fixed centre, or the clock can be a fixture and the centre of the barrel movable. The free end of the clock lever, H, moves between two spring buffers, p and p_1, of which p is provided with a stronger spring than p_1; therefore, when the clock spring is run down, and the pressure taken off the click, the end of the lever, H, moves towards p_1.

This movement brings a latch, R, into action, pressing or drawing same into a notch, E, in the guide-rod, L, thus blocking the guide-rod, L, and the automatic switch simultaneously.

The lever, I, I (figs. 1 and 2), carries on its extension, *h*, an indicator disc, N, which is always nearly held in balance and which on the pivot, *z*, is then appearing behind a glazed aperture, giving the warning to wind up the clock. When the key, G, is inserted, a small lever, *b*, is then pressed sideways bringing into action a flexible arm, B, which replaces the indicator disc.

Church Electric Lighting.—The electric light was switched on in Glasgow Free St. Paul's Church for the first time on Wednesday last week.

ON LIGHTNING RODS.

(*Concluded from page* 427.)

In a communication made to the Institution of Electrical Engineers, on April 25th, 1889, Prof. Lodge put forward some practical maxims, which were discussed by various of the members present. Some of these are a repetition of rules already generally adopted, whilst concerning others there exist well-founded doubts.

1. All the parts of a lightning rod, from the point to the exit, must be of one and the same metal, to prevent any voltaic action which may lead to corrosion.

2. Joints should be avoided as far as possible, and if inevitable, they should be substantially made. In an imperfect connection heat may be developed so as to melt the conductor, with the risk of fire.

3. Bends at sharp angles should be avoided. At abrupt curves the lightning is apt to spring from one point of the conductor to another, with the risk of rupture.

4. The employment of copper is useless.

5. Iron presents advantages over all other metals.

6. The form of the section is not important; conductors should be formed of many fine wires, distant from each other.

7. A diameter of the conductor of 5 to 6 mm. will be sufficient.

8. The discharge will divide itself among all possible passages, and many others considered impossible.

9. There should be a good, deep earth, besides what may be obtained by uniting the conductor to gas and water mains.

10. The conductor should be united to any adjacent mains, since the lightning will seek them out, and do damage.

11. If into the structure to be protected there enter gas and water pipes, the rod must in some manner be connected to all underground mains.

12. When gas and water pipes pass near each other, and, in general, when a metallic ramification is near another they should be in metallic connection.

(Nos. 9, 10, 11 and 12 are suggested for discussion.)

13. In erecting a lightning rod, we must avoid the vicinity of fusible gas pipes of small diameter.

14. Water or gas pipes should not enter into powder magazines, unless the entire structure is metallic.

15. It is not prudent to erect many high points above the roof of a manufactory. But O. Lodge regards this prescription as doubtful, especially when there is often beneath an explosive atmosphere as in powder mills, flour mills, petroleum magazines, &c.

16. Numerous points along the ridge of the roof are better than few.

17. Any part of a manufactory may be struck, and to protect it, all external projections should be united to a conductor.

18. As long as bodies are insulated they may give off sparks.

19. We cannot obtain absolute security without enclosing all the structure, including the pavement, with metal. But Bucknill raises doubt on this protection, and Thomson recommends that in magazines the powder should be kept at a distance from the wall and the pavement. A magazine entirely metallic will, as Thomson remarks, not need an earth.

20. In ordinary houses it is well to insulate the lightning rods from the walls, to diminish the chance of a lateral discharge. But Prof. Lodge raised serious doubts on this rule, and Col. Bucknill prefers to unite any metallic objects to the conductor.

21. Chimneys may be used for insulators to protect the masonry from damage. Prof. Lodge questions the suitableness of this arrangement.

22. The most economical method of protecting an ordinary house is to run a galvanised iron wire (like telegraph wire) along all the corners, the ridges, the gutters, and the chimneys, and to lead it to earth in several points, and there to bury it in a heap of coke. The gutters and other external metallic parts may also be utilised to constitute a kind of metallic cage.

23. Connecting a metallic roof or other extensive surface of the same nature, to a lightning rod, has an advantage,

because by increasing the capacity the violence of the stroke will be diminished. But it has the disadvantage that the rod is placed near objects which cannot remain distant. But Prof. Lodge thinks that the advantages exceed the disadvantages. Colonel Bucknill prefers to unite the metallic roof to two or more conductors at the extremities. Melsens suggests that all considerable metallic masses should be united so as to form a closed circuit. Colonel Bucknill would connect internal masses to the lightning rod, and keep the internal masses separate.

The rule generally accepted is to connect all metallic masses to the lightning rod. The rule of Prof. Lodge seems good, and agrees in substance with that of Thomson; it is to connect together all the metallic parts, and to give them a good earth without uniting it to the conductor of the rod, so as to lessen the danger of sparks.

24. There is the greatest difficulty in determining what objects should be connected to the lightning rod and what should not.

25. It is desirable that the mouth of a high chimney should be crossed by the conductor of the lightning rod, bent in an arch, and kept at this point very thick and resistant. For the arch we may substitute a metal hoop surrounding the mouth, and furnished with a point turned inwards.

26. The lightning rod should be external and easily visible.

26*a*. A lightning rod, distant from the building, is safer than one in contact.

27. The best method of protecting a powder magazine is to enclose it in a metallic cage fitted with points and having an earth, and to line it internally with another metallic cage having an earth not connected with the former.

Conclusions.

From the study of the question of lightning rods, according to the most recent advances in electric science, there result two facts :—

1. Lightning rods, such as are at present erected, do not in general give an absolute security.

2. It is difficult, at the present day, to obtain such security.

In buildings in which absolute security is necessary without regard to cost, *e.g.* in powder magazines, it may be obtained by the method of Maxwell.

STARTING OF SYNCHRONOUS ALTERNATORS.

By CAMILLO OLIVETTI.

LET us consider any alternate current synchronous motor. Let p be the number of poles, and suppose that p is a multiple of 4. When the motor is running the number of revolutions per second is $\frac{2f}{p}$, f being the frequency of the current.

Suppose now that the brushes of this alternator are connected together so as to have the armature winding in closed circuit. Then suppose also that the main current is, according to Hutin and Leblanc's suggestion, led into a divided path, into one branch of which a condenser is inserted, whilst in the other is placed a coil having a certain self-induction. If the self-induction and the capacity are suitably calculated, we have in the two paths two currents having a difference of phase near to 90 degrees, so that if we send one of these currents into the inducing poles 1, 3, 5, 7, ... and the other into the poles 2, 4, 6, 8, ... , we have a rotatory magnetic field, and its speed is $\frac{4f}{p}$, revolutions per second, that is to say, it has a speed double that of the armature when the motor is running as a synchronous motor. The winding being in closed circuit, the armature must run, as in ordinary multiphase motors, with a speed which will be certainly less than $\frac{4f}{p}$, but (if the load is not too great) will be more than $\frac{2f}{p}$.

In a like manner, when p is multiple at 6, we can send in the inducing coils three alternate currents having a difference of phase of 60 degrees, and the speed of the magnetic field will be $\frac{6f}{p}$ that is to say, it will be three times the speed of the synchronous motor. These remarks led me to imagine a method of starting synchronous motors.

Let us consider a four-pole separately excited alternator, shown diagrammatically in figs. 1 and 2. When we wish to

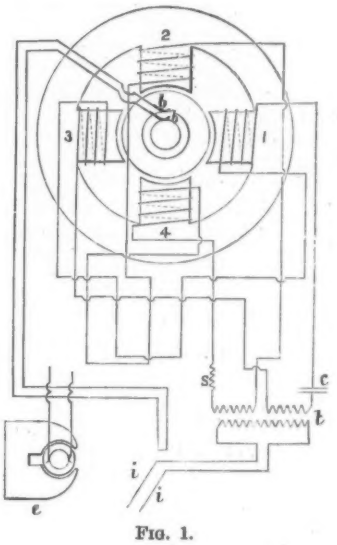


FIG. 1.

start the motor, we send the main current, i, into a transformer, t (fig. 1). This transformer has two secondary coils. One of these coils is in series with a capacity, c, and with the coils of the poles 1 and 3, the other with a self-induction,

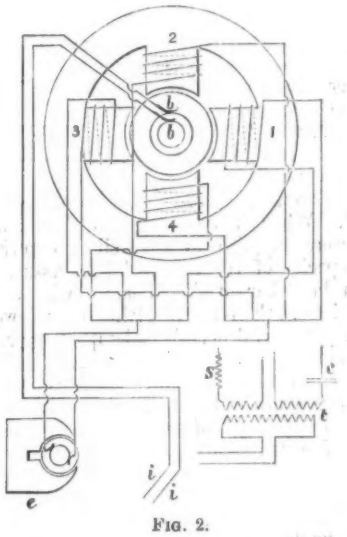


FIG. 2.

s, and with the coils of the poles 2 and 4. The brushes, b, b, are connected together, and the exciter, e, is not acting. Then the motor starts, and if the load is not too large, we soon obtain a speed between $\frac{f}{2}$ and p. We have several means of perceiving when the speed is more than $\frac{f}{2}$. One is to use an ordinary speed indicator, another to insert between the brushes an alternate current ampèremeter, which shows the value of the induced current in the armature. When this current is very small, the speed is not very far from f. When we have obtained a speed more than $\frac{f}{2}$, we can by switches or commutators readily insert the inducing coils in the circuit of the exciter, e, cut off the transformer, t, and connect

the brushes, *b*, *b*, with the main circuit, as it is shown in fig. 2, then the machine runs synchronously. All these commutations can be made automatically by some relay which is commanded by a centrifugal governor.

Analogous dispositions can be made for a machine with a larger number of poles.

NOTE ON LIFE OF INCANDESCENT LAMPS.

By C. H. YEAMAN.

Figures have been published from time to time with reference to the mortality of electric lamps run under practical conditions. The data have been in most cases so sparing in particulars that due allowance could only be made with difficulty for disturbing elements tending to raise or lower the observed values from the probable average life of such lamps.

In the case of a carefully run, private plant, operating about 200 Ediswan B.C. lamps, of 16 candle power, 100 volts, the following figures show the duration of the filaments of those lamps which died a natural death before attaining their majority of 1,000 hours working life.

Abnormal Mortality Return.

1 lamp gave way in 295 hours.
2 lamps gave way after 349 hours.
1 lamp at each of the following periods respectively :—385, 391, 546, 615, 706, 771, and 777 hours.
3 lamps failed after about 807 hours, and
1 at completion of 1,000 hours' service.

The remainder having done their duty, were not subjected to close attention. They continued in use without material depreciation in light giving power for various periods over 1,000 hours, a few showing phenomenal results both as regards life and maintenance of efficiency. (From average tests this could normally be considered to be ·25 C.P. per watt.)

The current was generated by a 24-horse gas engine, of Griffin pattern, well governed and double fly-wheels, driving a compounded Norwich dynamo, by double leather belting, well up to its work. The dynamo was fitted with a disc fly-wheel, rather above the usual weight. During the hours when dynamo was run for direct supply, a battery of 31 L E.P.S. secondary cells was worked at balancing point in parallel with the two pairs of feeding mains. On these the pressure was regulated at the supply ends by a voltmeter run off pilot wires brought back to engine room from distributing switchboard. When it was undesirable to run the engine, the lamps were supplied by the cells up to the maximum discharge capacity of the same. The pressure maintained constant on buss bars of distributing switchboard was 101 volts. The loss in the internal wiring was allowed for in the designs at 2 per cent. drop. The lamps appeared to be well up to C.P., and gave every satisfaction run in this way.

In another instance, the lamps in a factory were found to be liable to fractured filaments, due to irregularities and variations in the pressure of supply, although they were run as a matter of principle below the marked voltage. Similar lamps supplied from another source, and on a higher pressure which exceeded their normal by 3 or 4 per cent., did not show such early signs of failure, probably owing to the constancy with which the difference of potential on their terminals was maintained. From the results in practice, there seems to be some reason to believe that over-running is less harmful on a continuous supply than in cases where the alternating current is used ; but the conditions were not definite enough to permit actual measurements to be made.

THE LAMP SITUATION IN AMERICA.

In the *Electrical World* for April 15th, Mr. Terry renews, in a long letter, his plaint against electrical matters in general, and the General Electric Company in particular. He states that he has perused the various opinions that have been expressed, with interest, but it is evident from the strain of his remarks that his fears have not been in the least alleviated by the almost unanimous prediction of his several colleagues that the dreaded control is extremely unlikely to take place. The event may be improbable, says Mr. Terry, but assuming the chances in favour of entire control to be only one to a hundred, the situation may still be considered very serious. To relieve it non-infringing lamps would have to be fully equal to the Edison lamp. Future legal decisions *may* limit the use that can be made of the patent, but those which have been already delivered have leaned in the opposite direction by giving the lamp patentee full and free power to control the sale of certain other apparatus not covered by patents at all. But the lamp patent is not the only vital patent the company possesses. It owns other patents of great importance, *e.g.*, the feeder in electric distribution (which was recently decided in its favour), the Edison flashing patent, lamp socket patents, and other lamp patents, which will continue sound long after the original lamp patent has expired. Mr. Terry greatly fears the ability of Messrs. Coffin and Fish, who have charge of the General Company's legal affairs, and thinks that cases are not always decided on the principle of right or wrong, and that where other counsel might fail these gentlemen would succeed. Up to the present the company has been careful to cause as little antagonism as possible, but with all the outside lamp factories closed it will gradually be able to be more independent of outside dynamo manufacturers. It may even exercise its power to supply lamps for use on such dynamos of an efficiency which will make it impossible for any dynamos to compete with those of its own make. Furthermore, with its extensive capital it would be able to gradually obtain control of the most paying of the central stations, and "probably few are aware to what an extent this has already been done." After referring to the influence of competition in aiding the production of articles of superior quality, and expressing the conviction that the policy of the General Company was not likely to be other than a selfish and aggrandising one, Mr. Terry proceeds to say that he does not believe the patent laws were framed with the intention of permitting one patent to serve as a key to obtain control of a whole system of goods. There is no doubt that the aggrieved gentleman says *some* true things, and we heartily sympathise with him as well as with many another deserving labourer in the electrical field, who, through no fault of their own, are feeling the pinch of lessened profits and are anticipating still harder times. The general opinion, however, as regards the future, is certainly not nearly so desponding and gloomy as Mr. Terry tries to make it out to be, and many of his arguments and fears seem to us to be very far-fetched and groundless.

FACTS AND FIGURES ON ELECTROLYTIC CHLORINE AND SODA.

By EMILE ANDREOLI.

(*Continued from page* 522.)

The reports on the Electrolytic Caustic Soda and Chlorine Trust which I am now sifting, and which have passed unnoticed, appeared on April 10th, 1893, in the *Papermakers' Circular and Rag Merchants' Price Current*, and were pompously prefaced by the following commendatory words : "The accompanying reports from eminent experts seem to prove beyond danger of contradiction that the experiment at Snodland is a decided success."

I do not see what these eminent experts have proved beyond danger of contradiction, but no doubt, nobody after reading my notes and comments will contradict me when I say that the eminent experts did not prove anything of the kind. "I am satisfied," said Mr. Leith, "that they have overcome all the main difficulties hitherto impeding alkali manufacture by electrolysis, and I am of opinion that if large works were erected either in the north, near the supply of coal and salt, or wherever good water power is available to save the cost of fuel, both caustic soda and chloride of lime can be manufactured under the patents belonging to the Electrolytic Company, at a saving of about £5 per ton on the present prices charged for these articles by the Chemical Union at St. Helen's or Widnes." What are the main diffi-

culties hitherto impeding the electrolytic manufacture of bleach and alkali? When I contemplate the ruins of Carthage of Rome, of Egypt, the Colosseum, the Pyramids, the Parthenon, said an old French poet, how can I wonder and weep when my coat which I have been wearing for two years is worn out at the elbows? So with the anodes, and instead of lamenting, the five experts of the Electrolytic Caustic Soda and Chlorine Trust, Limited, should imitate the poet. The real difficulties have been, firstly, during many years, that there was no cheap electrical power at the disposal of the electro-chemist; besides, electrolysis was rather a little known science, since many electricians were neither chemists nor electro-chemists, and very few chemists were electricians; the capitalists have been therefore very cautious, and never invested their money in an electrolytical installation on a commercial scale. The Snodland Works are the only example of a practical trial of the production of bleach and caustic by the electric current.

There are at least three or four other processes which, if they had had the same chance of being supported by strong, stubborn believers in the future of electrolysis, would have given the same results with a larger saving, since the Richardson-Holland process is the only one which requires an E.M.F. of 6 volts. We must, therefore, because the experimental installation at Snodland is a great encouragement for others, heartily congratulate the people who have been supporting this process, and boldly attempted to bring electrolysis in the field of commercial applications. Let them continue, improve and manufacture bleaching powder and soda by electrolysis.

According to Mr. Leith, the production of caustic soda and bleaching powder in the United Kingdom alone must be at least 6,000 tons per week, or, say, 300,000 tons per annum, and nothing can be more attractive and seductive than the report of people who, like Mr. Leith, say that the saving of £5 represents for Great Britain alone £1,500,000 a year. This makes one's mouth water, although it looks a little exaggerated. However, this is true as long as the market prices remain unchanged. It shows, at all events, that the field is wide enough for all the makers of chlorine and soda by electrolysis.

As an alkali manufacturer, Mr. Leith pays more attention to caustic than to chlorine, and we are not much advanced when he says that he has found that the decomposition of salt goes on *uniformly*, *steadily* and *quietly*, and is in *every respect* most *compact* and *clean*. "The increase of alkali is so constant, he adds, that it is always possible to ascertain exactly what can be done in a given time; the chlorine gas, of course, *passes off as steadily* as the alkali increases, and what seems of very great importance is that there appears to be no loss."

This phraseology and combination of adjectives, adverbs, and general description of the production of chlorine and caustic soda are so tame, and so little supported by figures, that it does not convey much to our mind; but I am struck by the passage where Mr. Leith says that "one of the great advantages of the process is its capability of being worked by manufacturers generally on their own premises; spare engine power is usually available in all manufactories to drive a dynamo, and the brine decomposing tanks cost so little, occupy such small space, and the whole arrangement is so compact, simple and cleanly in every respect, that there is nothing to prevent any user of caustic soda and chlorine manufacturing as small or large a quantity as he requires on his own premises, thus saving all the cost of solidifying the soda, absorbing all the chlorine in lime, and packing in drums and barrels for transport purposes, as well as the cost of conveyance, all serious items now in the price charged by the alkali trade."

Have the papermakers really a spare engine which is available for manufacturing the quantity of bleach and caustic soda they want every day? During the period Mr. Leith had the control of the works, he used only 13 out of the 21 brine decomposing tanks fixed, and turned over 5 tons 8 cwt. at a time; the electric current was continuously maintained day and night from 500 to 520 ampères at 80 volts, the indicated horse-power of the engine was 81, friction included. "This," he adds, "with a more modern class of engine, might be reduced to 50 H.P., and the cost of coal by, say, 35 per cent."

It is very interesting to compare what Mr. Leith says, in the above-mentioned sentence, on the motive power, with what another expert says in *Industries*:—"The Electrolytic Caustic Soda and Chlorine Trust have erected a model works at Snodland, which is large enough to demonstrate the manufacture of caustic and bleach on a commercial scale. The plant consists of a 50-H.P. engine and dynamo. With these we are not concerned in the present case, as the efficiency of engines and dynamos are well known already. The dynamo gives 80 volts, and the circuit is led to the vat room, the vats being connected in series. A pressure of 6 volts is allowed for each vat, which is somewhat high, but experience at Snodland has led to the adoption of this figure." But the writer of the lines we have just quoted has since sent us a note to tell that there was an error, and that the engine is *150*, not *50* H.P.

This difference between 50 and 150 is really worth noting.

Mr. Leith does not tell us much more on the caustic soda solution than on the quantity of chlorine gas obtained. "Whatever undecomposed salt may be left simply falls to the bottom of the evaporating pans in the usual way, and is carried back to the salt store." This does not show what the density of the alkaline liquor is when run off.

The expert who wrote the description of the manufacture of bleach and caustic at Snodland had said in his article in *Industries*: "The vats are of such a size that, with 6 volts pressure, the liquor gains 1 per cent. of caustic per day. It is generally run off at 4 per cent., he writes us: *the solution is drawn at 14, not 4 per cent. of strength.* The chlorine is led off, and is conducted to milk of lime agitators, where it is absorbed, and to an ordinary bleach chamber. The milk of lime is best when the bleach is to be used at once, as at Snodland, where it is supplied to a large paper mill close to the works. The bleaching chamber is used to demonstrate the manufacture of ordinary bleaching powder. The caustic liquor, which still contains a large amount of salt, is evaporated down. The salt crystallises out, and is sent back to the vats again. The caustic made by this process is entirely free from sulphate and carbonate, and practically free from chloride." Again there was an error, and really compositors ought to pay more attention to what they are doing! In 12 lines there have been two misprints: the engine is not 50, but 150 H.P., and the caustic liquor is not run off at 4 per cent., but at 14 per cent. strength. I make *this light correction*, as our amiable correspondent calls it, but 4 instead of 14, and 150 H.P. instead of 50, seems to me a rather large difference. In fact, incorrect figures in a report make all the difference.

There is something touching and poetical in the statement prepared by Mr. Tate, F.C.S., analytical and technical chemist, of Liverpool, who has been engaged in watching and testing the progress of the electrolytic process at Snodland, and in the analytical examination of the products obtained.

He says:—"The ease and uniformity of the decomposition of the brine by the electric current are most remarkable." Then we learn from him that the brine, consisting of a saturated solution of common salt, is readily acted on by the electric current from the dynamo, giving a steady and continuous yield of caustic soda solution, and of chlorine gas. This is, indeed, a very remarkable fact, and readers of the ELECTRICAL REVIEW will no doubt be extremely surprised at this decomposing action of the electric current on a solution of salt. Perhaps, however, they would have desired a few figures explaining what a "steady yield of caustic soda and of chlorine gas" is, as the yield of caustic soda and of chlorine gas may be steady and constant, but, at the same time, more or less weak.

This report is a wonderful source of precious revelations, of which no one in the scientific and industrial world had ever conceived the slightest idea.

For instance, Mr. Tate tells us that "The caustic soda solution is suitable for use by paper-makers, as it comes from the decomposing tank containing over 10 per cent. of alkali (Na_2O), or it is readily concentrated by boiling down in the usual way, yielding a superior quality of solid caustic soda.

Listen to the following! Is it not simply marvellous?

Bleaching powder is obtained by passing the chlorine gas into chambers containing lime; a bleaching quality and strength is produced by absorbing the gas in milk of lime.

I pass over what Mr. Tate says about the advantages which the electrolytic process possesses over the Leblanc and the ammonia process; but when I come to the end of this empty statement, not worthy of the name of a report, I note this declaration, against which all electricians will protest,

because the expert has no facts or figures on which to base his testimonial of superiority of the Snodland process over the other electrolytical processes already in existence :—

"*As compared with other electrolytic processes, the Richardson-Holland process has the advantages of simplicity and economy, dispensing as it does with the use of costly and defective diaphragms.*" What does the expert know about the diaphragms used by other electro-chemists? Neither Mr. Leith nor Mr. Tate have any right to speak of the simplicity and economy of the Snodland process. They are not, at all events, qualified to claim economy for a process which requires 6 volts instead of 5 or 4½. There is certainly a great saving in the production of chlorine and soda by electrolysis, when compared to the chemical process, but the Snodland is, up to the present, the least economical which I know of.

Let us now have a little enjoyment out of Mr. Massey's report, who gravely says :—

"The weak point in all schemes for the decomposition of salt by electrolysis, *although it has not been generally recognised*" (How do you know this, Mr. Expert? Are you sure of it?) "is in connection with the anodes, which, even when made of hard carbon, disintegrate in the tank under the action of chlorine." (And of oxygen, if you please!) "I am at last convinced," says Mr. Massey to the directors of the Electrolytic Caustic Soda and Chlorine Trust, Limited, "that you have solved the important question of anodes."

As for me, I am confident I have made clear that if the sole fact of using slabs of retort carbon in exactly the same manner as Le Sueur and Gibson constitutes the solution of the problem of the electrolysis of salt, the Snodland people have not solved any difficulty at all.

In cauda venenum. The report of Mr. Massey is as devoid as the reports by Mr. Tate of figures and facts, establishing a real superiority on the other electrolytic systems; on the contrary, there seems to be something in the Snodland process which looks unsatisfactory, since Mr. Massey, at the end of his paper, says :—

"What struck me very much at Snodland was the simplicity of the work, as well as the clean, healthy look of the place, and of those engaged there; but I think that something can be done to still further economise labour, by so arranging the tanks that the supply of brine will be perfectly automatic. I understand you have patented a process for this, and I am sure that by such means the cost of turning out caustic soda and bleach can be still further reduced, *besides your getting a more uniform volume of chlorine gas and a more concentrated solution of caustic soda.*"

Does Mr. Massey mean by this that the actual *volume of chlorine gas is not uniform*, and the *solution of caustic soda not sufficiently concentrated?* It looks very much like it.

I will soon have finished with this most unpleasant task of criticising a process brought before the public and represented by eminent chemical and electro-chemical experts as the only one which has solved the difficulties of commercial electrolysis of salt, and the only one cheap, efficient and perfect.

My turn may come to have to submit to the appreciation of competent experts a method for producing, commercially, chlorine and caustic soda by electrolysis. Then, those whom I have criticised will have their day: I will beg the favour of a strict, severe, close examination of all the parts of my electrolytic apparatus, and of the working of the whole process. The stronger the test the better the results, if the conclusions arrived at are favourable.

Is it not preferable in the interest of all those interested in commercial electrolysis to have pitilessly condemned ten processes which are insufficient and imperfect, than to have one complacently adopted, while it really may be inferior to the others?

(To be concluded.)

Imperial Institute Honours.—In connection with the opening of the Imperial Institute, Her Majesty has been pleased to approve the following appointments: Lord Herschell, to be an Extra Knight Grand Cross of the Order of the Bath; Sir Frederick Abel, K.C.B., to be a Baronet of the United Kingdom; and Sir Somers Vine, to be a C.M.G.

TELEGRAPHIC COMMUNICATION IN THE WEST INDIES.

How Trade and Intercourse may most Successfully be Restricted within the Narrowest Limits.

By Dr. R. B. ANDERSON.

(*Continued from page* 518.)

I BEGUN my former article modestly enough, I trust, by undertaking to show how the development of one of our smallest colonies has been systematically retarded; and the illustration I took was the refusal to Tobago of telegraphic communication with the rest of the world for many years after her sister colonies had obtained that advantage. I begun, too, with an apparent suppression of important facts, without apparent object for that suppression, by the Local Government of that colony; such as it is my special function to expose; so that no one could accuse me of "going beyond my last." Now, from this small beginning, I find myself in possession of what may prove to be a clue to a labyrinth of intrigue; which, with more or less of confidence, I must follow to the centre, if the clue will hold; and surrounded by jostling interests and surging factions which I hope may not quite overwhelm me.

In plain terms, as soon as my article appeared, I received a visit from Mr. Rippon, the energetic managing director of the Halifax and Bermuda Cable Company, who, finding that I am interested in seeing the terms of traffic and communication with the West Indies reduced to rates that will render it possible to make a decent living in those colonies, came to me about the proposed extension of their line to Jamaica.

He explained the difficulties they find in coming to a practicable arrangement with the West India and Panama Cable Company, owing to subsisting contracts of that company with the various lines through which messages have at present to be transmitted to Europe: and he gave me much valuable and, I am sure, authentic information, the application of which, to the best interests of the West Indies, I propose to weigh most carefully, so as, if possible, to secure results that can be relied upon by all who are interested in the development of telegraphic communication, and the increase of electrical business.

I have spoken of the existing rates as practically prohibitive and restrictive, strangling business at its very birth; and have mentioned that the argument against reduction is that it would not be attended with any adequate extension of business or multiplication of messages.

It would appear that all men are not influenced by this argument, and that the experiment of greatly reduced rates, even for telegraphic communication in the West Indies, has very confident advocates. And certainly I am not likely to discourage in the least any efforts towards a consummation so devoutly to be wished. I have always considered that low rates are the only method of greatly extending business of all kinds, and I have never believed that the West Indies are an exception to the rule, either as to passenger, freight, postal, or telegraphic rates. I have always wished to see the experiment of fairly low rates tried in the West Indies; and if I am not greatly deceived, the new movement for the assertion of the claims of those colonies in all respects will, in the course of a very short time, be in a position to ensure that it shall be tried.

Being in communication with the West India and Panama Cable Company, and those communications not having, as yet, come to any issue, I do not think it would be fair to them to enter into the claims of the Halifax and Bermuda Cable Company, or into the differences which at present exist between that company and themselves, although I cannot help expressing a hope, in the interest of the West Indies, and, indeed, in the interest of both companies, for their speedy arrival at a satisfactory understanding.

I have been so much engrossed with the political aspects of that movement, that many most interesting facts cognate to its more general objects have, for the time, escaped my attention, and I am greatly indebted to Mr. Rippon for having brought to my notice measures that are in active progress which, I think, must secure the approval of all connected with the West Indies, who have not personal ends to serve with which the new measures may interfere.

One of these is the formation of the Canadian West India Trading Association, the object of which is to secure a share of West Indian commerce with Canada, and, whilst as a West Indian I am not ungrateful to Uncle Sam for some mutual good offices in the past, as an Englishman, I must rejoice at the forging of every fresh link that tends to bind more closely together the various portions of our mighty Empire; and I must hope that they will be links of gold, (produced by the mighty alchemy of electricity out of cables of copper), and must do all I can, however little, to help in the process.

With such interests growing up, it cannot be matter of surprise that there is also growing up a desire that our means of telegraphic communication shall be, as far as possible, within our own borders and under our own control; or that the Halifax and Bermuda Cable Company should rely on these interests and these sentiments. Should the West India and Panama Cable Company be in a position to do so, I feel sure that they will be equally ready to meet such views, which in the most practical manner seek to combine good business and good patriotism. To all these very interesting matters I hope to be in a better position to do justice in my next.

In the meanwhile I revert to my smaller theme, the necessity for the establishment of telegraphic communication between Trinidad and Tobago; lest instead of showing how *not* to do it, I should begin to show how it is to be done. I have, I think, shown conclusively that communication is essential for purposes of Imperial defence, and in the interest of British Guiana and Trinidad, as well as of Tobago; and also in the interests of the people of both colonies, by rendering it possible for Trinidadians to avail themselves of Tobago as a health resort without incurring the grave penalty of being cut off from all means of prompt communication with the rest of the world, and particularly with Trinidad; or, in the case of other visitors, without their being similarly cut off from all communication with wherever their business may be situated.

And the converse of this proposition is equally true. If the absence of telegraphic communication tends to keep the population of Trinidad, and other West Indian colonies, or this country, from having recourse to Tobago; on the other hand, the great extension of such resort to Tobago would call into existence an irresistible demand for, and a greatly increased employment of telegraphy. In all that tends in this direction the West India and Panama Cable Company are far more interested even than other West Indians, if they will but see it. I am cordially inviting their co-operation in working for the necessary changes; and if they are not of the type, or if they have not shared the fate of Rip Van Winkle, they will see where their interest leads.

The present arrangement of the Royal Mail communication on the Trinidad-Tobago route, is that the steamer of that route leaves Barbados on the Monday, calls at St. Vincent and Grenada on Tuesday, arrives in Trinidad (Port of Spain) on Wednesday morning, lies there till Wednesday evening, and then proceeds to Tobago, arriving there on Thursday morning. One voyage she lies in Tobago till the subsequent Wednesday, when she returns to Trinidad Thursday morning, Grenada and St. Vincent Friday, and so to Barbados; but the next voyage, instead of lying at Tobago, she proceeds to La Guayra, the harbour of Carraccas in Venezuela, arriving on the Saturday and returning on the Monday to Tobago.

And here comes in an illustration of the art "how not to do it" at the hand of our friends, the Royal Mail Steam Packet Company.

In passing each way between Tobago and La Guayra, the route of the vessel is along the northern coast of Trinidad, and within a few miles of the Bocas, so that a deviation of, say 20 miles, would take the vessel each way into Port of Spain, would give direct communication each way between Port of Spain and La Guayra, and would give *double* connection of the most convenient possible intervals between Trinidad and Tobago as follows:—Port of Spain, Wednesday afternoon; Scarborough, Tobago, Thursday morning, leave afternoon; Port of Spain, Friday morning, leave promptly; on to La Guayra; back from La Guayra; touch at Port of Spain, Tuesday afternoon; Tobago, Wednesday morning, leave Wednesday afternoon; back to Trinidad, Thursday morning; and so on, usual route, to Grenada, St. Vincent, and Barbados.

I had been thinking of the advantages of this arrangement, and had heard in Port of Spain that Venezuelans, many of whom travel from La Guayra to Port of Spain and *vice versa*, objected very much to having to go 70 miles out of the way to touch at Tobago, and 70 miles back to Port of Spain; this being for them an extra and unnecessary 140 miles of sea voyage, besides the loss of nearly two days' time.

I had even seen the company's agents on the subject, and had discussed various ways in which the double communication might be effected.

On one of my many voyages at that time between Tobago and Trinidad, I made the acquaintance of a gentleman from Caraccas, who had come by that route, not knowing that the steamer went on first to Tobago before touching at Port of Spain, and he confirmed my previous information.

At my request he gave me a letter vouching for its correctness, which I will give *in extenso*, with my own to the company's agents, and their reply, as I think such clear and practical proof of the perfection attained in those parts, of the art of how not to do it cannot fail to be of interest; whilst it must not be forgotten that the great masters who gave the illustration of this art have their headquarters in Moorgate Street. Mr. Leonce Gueydan's letter is as follows:—

Port of Spain, *October 1st*, 1890.

Dr. R. B. Anderson.

Dear Sir,—Your favour of September 29th was duly received, and I hasten to comply with your request.

I have been told by several persons in Caraccas and La Guayra that they would gladly avail themselves of the opportunity of taking the Royal Mail Steamship Company's steamer from La Guayra to Trinidad if it were not for the call at Tobago previous to reaching this port.

The Royal Mail Steamship Company is a favourite with travellers on account of the punctuality and good accommodation of their steamers, but the travelling public say, and I am of their opinion, that this call at Tobago is a great drawback that could easily be avoided.

I have no pretension to suggest anything to the company, but I think they could make their steamers leave La Guayra at 8 or 9 o'clock on Monday morning, so as to reach here at 4 p.m. on Tuesday. They would then have time to land passengers and mails and proceed to Tobago the same evening.

Hoping that you will succeed in gaining your point,

I remain, dear Sir,

Yours very respectfully,

L. P. GUEYDAN.

I then wrote to the agents, conveying Mr. Gueydan's letter.

Tobago, *October 6th*, 1890.

Messrs. Scott and Sons, Agents R. M. Steam Packet Co.,
Port of Spain.

Dear Sirs,—I represented some weeks since to your senior the great advantage that would result in several respects from a communication being arranged between Port of Spain and the Royal Mail Steam Packet Company as she passes the Bocas on her way from Tobago (after delivering the outward mail to that island) to La Guayra; and again, as she passes the Bocas from La Guayra on her way back to Tobago, to pick up the homeward mail before coming to Port of Spain. I am writing this in Port of Spain, though I have headed it at Tobago, as I expect to go there to-morrow. I think we calculated, on that occasion, that each communication by a suitable launch, or other small steamer, meeting the packet just inside the Bocas, might cost two tons of coal, &c., say, £5, whilst if the packet herself came up to Port of Spain each time, a deviation of less than 20 miles each way each time, the cost would, I suppose, be hardly greater, and the convenience far more. The chief grounds I urged on the attention of the company were, that I had heard from several sources that, owing to the call at Tobago lengthening the passage from Port of Spain to La Guayra by 140 miles of sea travelling, and 24 hours or so in time, the company loses many La Guayra passengers who otherwise would prefer to travel by their vessels.

This is strongly confirmed by information afforded the last time I came from Tobago by Mr. Gueydan—a traveller from La Guayra by the same packet—and he has kindly placed that information at my disposal in the form of a letter, of which I enclose a copy.

It is evident that were even two more passengers each way to and from La Guayra to be secured by the change, the expense would be covered, and I believe the number added would be far more than that.

As I explained, however, *my* interest is in thus securing complete communication weekly with Tobago; since I regard Tobago as the natural health resort of this part of the West Indies, but especially of Trinidad; and since the greatest obstacle to its being had recourse to is the want of more frequent and regular communication with it. I am in hopes of shortly seeing a cable laid from Toco (Trinidad) to Tobago, as the result of inquiries and efforts I am making as hon. secretary of the Planter's Club; but nothing could be more conducive to the success of the project I have mentioned, than the regular weekly communication by Royal Mail packet; as well shown by your senior's remark to me, that had there been such communication, he would himself have lately taken his family for a change to Tobago, instead of to Monos, or the Islands in this Gulf (Paria)—I forget which; and would for several reasons have preferred to do so,

Of course this alteration does not affect the English contract route, and would at first be chiefly for the convenience of passengers between Port of Spain and La Guayra; but I feel sure a short trial would prove it profitable, and it would inconvenience no one, whilst affording some prospect of greatly increasing the passenger traffic between Trinidad and Tobago, and enabling Trinidadians to take much fuller advantage of the opportunity now within their reach. As you have kindly promised to forward any representation on the subject, I am writing to one of the Vice-Presidents of the Club who is now in London to seek an interview with the directors there, and press the matter as fully as possible on their attention. For the information of the directors, I may mention that I have practised for 17 years as a medical man in Tobago, so that, in speaking of its suitability and advantages as a health resort, I do so advisedly, and on the ground of professional experience.

Yours faithfully,
R. B. Anderson.

To which Messrs. Scott & Sons replied :—

Dear Sir,—We are in receipt of your esteemed favour of the 6th instant, and have the pleasure to announce to you that we forwarded a copy of your remarks, together with a copy of Mr. Gueydan's letter enclosed in yours, and thank you for the trouble you have taken in the matter.

We are, dear Sir,
Yours faithfully,
Scott & Sons.

If my memory serves me well, and as would appear from my letter, at the time I wrote it, the steamer made the La Guayra voyage each fortnight, instead of, as subsequently, only each alternate fortnight.

I am unable to say whether this change was made as a mark of resentment at receiving my suggestion for the increase of their dividend; or whether it was because, by their strenuous efforts to do so, they had eventually destroyed their trade with La Guayra. What I have to mourn is the failure to persuade them to make a change at only a very slight risk in increased expense, that I think might reasonably have been expected to be productive of great advantages to Tobago, and to Trinidadians; and what justifies West Indians, who are the victims of such amazing obstinacy and perversity, in being angry, if it were ever worth while to be angry, is that the change could not have failed to be as beneficial to the Royal Mail Company as to the other interests that awaited this improvement.

This is not the only instance of such mistaken judgment on their part; and I hope, in my next article, to be able to enter on a much larger aspect of this art how not to do it, and also to show some judicious contrasts in the shape of ways in which encouragement should be judiciously afforded to suitable undertakings.

ELECTRICAL PUMPING PLANT.

An installation of electrical pumping machinery has just been designed and fixed by Messrs. Easton and Anderson, Limited, at the brewery of Messrs. Warwicks and Richardsons, Limited, Newark-on-Trent, which possesses several features of interest.

Mr. J. F. Warwick (on behalf of the company) in seeking for an independent supply, found, about a year ago, a source of water suitable for brewery purposes by sinking a well in a field about a mile and an eighth from the brewery, and at the same time conceived the idea of pumping up this water by means of electricity to the tank at the top of the brewery, generating the current at the same place, and transmitting it to the pumps by suitable conductors.

Accordingly, he placed himself in communication with Messrs. Easton and Anderson, Limited, who undertook to carry out the work, and received the order from the company in September last for doing so.

The question at once arose—Should the conductors be overhead or underground?

It was manifestly better that they should be underground, as it avoided the use of unsightly poles and wires, which would be more liable to injury, though, of course, more accessible for repairs; the cost of underground cables suitable for the purpose appeared at first sight, however, to put them altogether out of court.

There was, however, one circumstance in which this work differed from the ordinary electric transmission plant, and that was, that a water pipe had to be laid to the brewery from the well, and this involved getting out a trench. It occurred to Messrs. Easton and Anderson that, if a pair of cables could be laid in the trench at the same time as the pipe, the cost would be very materially reduced, and on going into the matter it was found that while the plan would not be cheaper than posts and naked overhead conductors, it was not very much dearer; so that it was eventually decided to use the underground system. It was thought at one time that the pipe main might have been used for a return instead of a second cable, but the idea was not acted upon.

It was considered desirable to be able to automatically vary the speed of the motor by varying that of the engine, and this condition was easily fulfilled by making the dynamo and motor both series wound.

The plant now stands as follows :—

The dynamo is of the "Whitehall" type, having slotted armature and double magnetic circuit, the field magnets being of cast-iron. It is, as before stated, series wound for 360 volts and about 1·5 ampères at 900 revolutions.

It stands on sliding rails, and is driven by a link belt from a countershaft, which derives its motion by a belt from a horizontal single cylinder non-conducting engine, which, with the countershaft, was already in existence. At present this engine does very little other work, but as it is too large for the pumping, it is contemplated to use it for other purposes, and therefore the pulley on the countershaft, which drives the dynamo, is fitted with a friction clutch, which enables the dynamo to be readily started or stopped as required, independently of the engine.

Suitable fuses and cut-outs are provided in the engine house, and from them the cable is led to the pumps. An ammeter is also fixed here, so that the engine driver can see that the current is being properly supplied. The cable was made by Messrs. Callender & Co., and is of their armoured type, so that it cannot easily be injured as it lies in the ground. The conductor consists of seven wires, each ·054 inch diameter, giving a total sectional area of 0·0155 square inch and a maximum resistance of 2·84 ohms per mile, insulated by means of a solid sheet of vulcanised bitumen, taped and secured with jute yarn, armoured by means of 20 galvanised iron wires, and finished by a braiding of hemp yarn well compounded. It is laid in a special trench for a short distance, till it joins the delivery pipe main leading to the tank, and from thence the two go together to the pump house, at a depth of about 2 feet below the surface of the ground.

There are only two joints on each of the two cables, and as the workmen laid the pipe they laid the cables, one on each side, in the trench, leaving the part to be jointed open till the work was done, when a special man was sent by Messrs. Callender, who made the joints and tested the line.

The pipe main consists of 5-inch cast-iron socket and spigot pipe, for the most part jointed in the ordinary way. At one point the pipes have to cross a railway bridge over a canal, and here—in order to occupy as little space as possible—they are of wrought-iron with flange joints, and are made only 4 inches diameter, carefully enclosed and lagged to keep them from the effects of frost, the cables also being included in the same casing to preserve them from injury.

The ground is low and wet, and the pipes and cable in some places pass under ditches, and were then actually laid below the water level.

The pump house is situated a few yards from the well. The outlet from the rising main at the tank is 70 feet to 80 feet above the surface of the water in the well.

The pumps are of the ordinary three-throw type of Messrs. Easton and Anderson's standard pattern, with gun-metal valves. The barrels are 5½ inches diameter, and 12 inches stroke.

The pump crankshaft is driven from a countershaft by means of a cast-iron pinion and wheel, and the motor, in its turn, drives the countershaft through the medium of a gun-metal pinion and a mortice wheel, the teeth of which are accurately machined to a special shape.

The motor is fixed on a concrete foundation, in such a way, that it is readily accessible on all sides, which is a very desirable thing where space permits.

It is of the same type as the dynamo, and is likewise series-wound, to run with 260 volts at a speed of 600 revolutions, at which the pumps will make 28 revolutions per minute, and

are calculated to deliver 5,000 gallons per hour to the brewery.

The bearings of the motor are made self-oiling, by having each brass bush made in two lengths, with a gap between them, in which an endless pitch chain of brass rests on the spindle, and dips into an oil well beneath the bearing.

When the spindle rotates it carries the chain round, and brings up a supply of oil, which is deposited on the spindle, and finds its way along the bearings by means of grooves, eventually returning from the outer ends of the bearings to the oil receptacle.

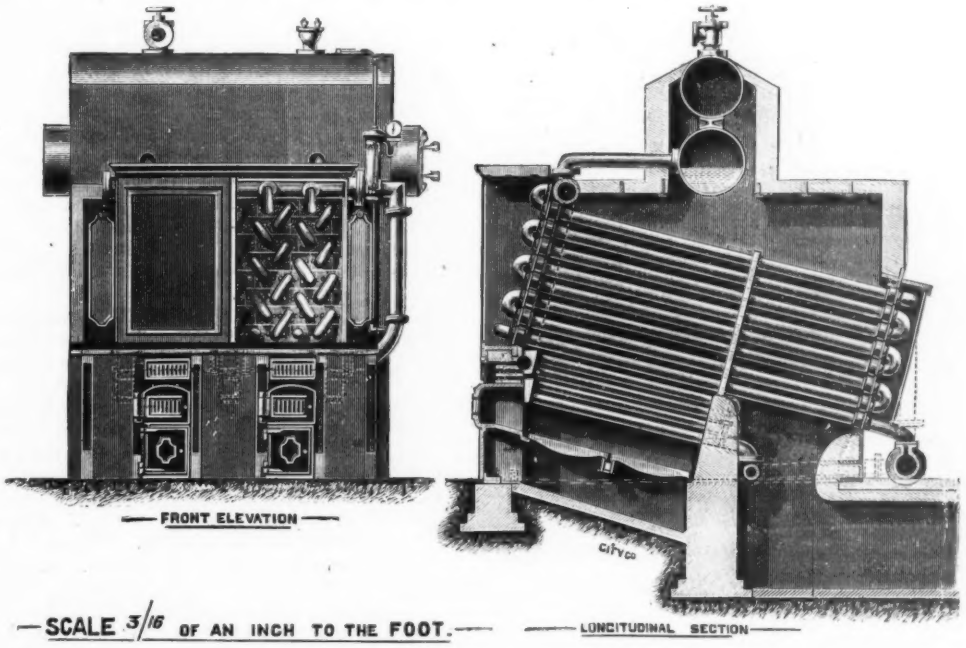
Thus the motor may run for weeks, or even months, without any attention to the lubrication being necessary.

The lubricators on the pump are of the ordinary needle type, which lasts a considerable time without attention.

For stopping and starting the motor at the pump house, a suitable switch and resistance frame is provided.

IMPROVEMENTS IN BOILERS.

REFERENCE was made in our issue of April 21st to Mills's improvements in the Babcock and Wilcox boilers, consisting of the addition in the furnace of an internally-fixed shell boiler. This, however, it is pointed out, destroys the important feature of safety from disastrous explosion. An attempt has been made to overcome this by Mr. Conrad Knap, who has recently patented some improvements in the Roots boilers. In the new form of these boilers the furnaces are surrounded and separated by 4-inch tubes set about $\frac{7}{8}$-inch apart, about 1 inch clear of the brickwork. *Two* rows can be used instead of one, if desired, but *one* is found sufficient in ordinary cases for absorbing the heat otherwise lost by radiation through the brickwork.



These tubular water furnace casings are made entirely of wrought-iron and steel, connected to the rest of the boiler, and the tubes are joined together in the same way as the boiler tubes themselves. It is *not* a separate water heater, but part and parcel of the boiler itself, through which the most rapid circulation takes place.

Boilers with long tubes are cheaper to produce per 100 square feet of heating surface, but the advantages of *short* tubes, such as are used in the construction of the improved Roots boiler, are, the much higher rate of evaporation per square foot of heating surface, greater facility in cleaning, and less danger of burning out when forced.

LEGAL.

SUREN, HARTMAN AND CO. v. W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED.

HIGH Court of Justice.—Court of Appeal. (Before Lords Justices Lindley, Bowen, and Kay.)

This was an appeal on behalf of the defendants, heard on Monday last, from a judgment of Mr. Justice Stirling, dated March 16th. The matter in dispute was as to the construction of a clause in an agreement between the parties. In the year 1886 the International Cable Company was formed to lay down submarine cables, that company having obtained a concession from the government of Portugal for leave to lay down cables to Canada *via* the Azores, the concession and monopoly to last for 20 years. On November 2nd, 1886, the International Cable Company entered into a contract with Henley's Company, under which the latter were to manufacture a large amount of cable. Soon after this a contract was entered into between the plaintiffs, Suren, Hartman and Co., and the defendants, the undertaking being that the plaintiffs should take 500 shares in the International Cable Company, paying £250 on application and £250 on allotment, but that the defendants should indemnify the plaintiffs against the payment of any further calls on those shares, and should, within two months of receiving an order to manufacture all or any of the cables, repay the plaintiffs the full amount which they had paid upon the shares, either in cash or fully paid up shares. The order to manufacture had never been given, and the plaintiffs sought to recover the £500 which they had paid. The defendants contended that their payment of the money was to be contingent on the order being given for the manufacture of the cables, and as no such order was ever given they were not liable. Mr. Justice Stirling held that they were, and defendants appealed from that judgment.

Mr. A. J. Ram appeared for the appellants, and Mr. Phipson Beale, Q.C., and Mr. Willis Bund, for the plaintiffs.

Mr. RAM having stated the facts, contended that by the terms of the contract they were not called upon to repay the £500 on the shares unless they got the order for the manufacture of the cables, and in reply to the Lords Justices as to the consideration which the plaintiffs were to receive for their payment, said it was a joint risk entered into in the expectation of considerable profits, Messrs. Suren, Hartman and Co. expecting to supply the wire required for the cable.

LORD JUSTICE LINDLEY said they need not trouble Mr. Beale to reply. It was obvious that the plaintiffs took the shares simply as the trustees for the defendants, and at once handed them over. The clause as to the repayment within two months of the order being given was merely a statement of the time for the repayment, and a stipulation that the defendants, in the event of an order being given, should have the option of making the repayment, either in cash or in fully paid up shares. He could not for the life of him see how the defendants could, on the agreement, raise the contention which they did. It would be monstrous if they were not to pay the £500.

LORDS JUSTICES BOWEN and KAY concurred, and the appeal was dismissed, with costs.

THE IPSWICH ELECTRICAL SUPPLY COMPANY *v.* ILIFFE.

IN the Queen's Bench Division on Tuesday, the case of the Ipswich Electrical Supply Company, Limited, *v.* Iliffe, came before Mr. Justice Cave and Mr. Justice Lawrence sitting as a Divisional Court. This was an appeal by Messrs. Thomas Bolton and Sons, electrical engineers and manufacturers of electrical appliances, of Birmingham, against an order of Mr. Justice Mathew, directing the receivers in

the action of the Ipswich Company *v.* Iliffe, to pay certain moneys to the applicants after other claims had been satisfied. Messrs. Bolton asked that the restrictions imposed should be removed, and that their claim should be at once satisfied.

Mr. Asheton Cross and Mr. George Wills appeared for Messrs. Bolton in support of the appeal; Mr. Isaacs appeared on behalf of the companies concerned.

Mr. CROSS said Messrs. Bolton & Sons were execution creditors of the Acme Electrical Works at Chalk Farm, having obtained judgment for electrical machinery and goods supplied to the amount of £99, but they were unable to get execution of that judgment because there was a receiver appointed to that company, and the receiver reported that there were prior claims. The judgment was also met by an affidavit by the manager of the Acme Works, saying the works had been transferred to the Ipswich Electrical Supply Company. The appellants, in the course of a considerable correspondence, in endeavouring to obtain payment of their debt, were for a long time in ignorance of the transfer of the business, and did not know but what they were still dealing with the Acme Company. Mr. Teague, the manager and a director of the Ipswich Company, conducted the correspondence, and, if the Ipswich was a limited company, he had been acting illegally by omitting to use the name of the limited company in the correspondence. The Acme Company was carried on by Mr. Iliffe until last August, when he transferred the business to the Ipswich Company. Disputes having arisen between the Ipswich Company and Iliffe, Mr. Teague and Mr. Aiken were appointed manager and receiver of the company. Mr. Aiken was appointed in the interest of Iliffe. Aiken was himself a judgment creditor. If it was left to these two persons to wind-up the affairs of these companies there would never be any winding-up, and Messrs. Bolton would never get their money. The learned counsel suggested that the internal disputes were raised, and the receivers appointed in this way merely to defeat Messrs. Bolton's judgment, and to prevent execution being levied on the assets. The two receivers ought not to pose as officers of the Court, because they were creditors of, and interested in, the company.

Mr. WILLS, following on the same side, said the effect of the order was discussed at the time it was made before Mr. Justice Mathew, and the view of that learned judge was that Messrs. Bolton would have to wait for their money until the receiver was winding-up his receivership dealing with all claims made upon the property.

Mr. ISAACS said it was Mr. Justice Wright who suggested the appointment of a receiver and manager; it was not by collusion, as suggested. An injunction had been applied for by the Ipswich Electrical Company against Mr. Iliffe, and upon that Mr. Justice Wright made the order restraining Iliffe continuing in possession, and said the best thing would be that Messrs. Aiken and Teague should be appointed receivers and managers until the whole thing could be disposed of.

Mr. WILLS said the order was made by consent, and the effect of it was to shut out all creditors who, like Messrs. Bolton and Sons, had a *primâ facie* right to be paid their debts out of the property known as the Acme Works. It ought to be determined in a reasonable time to whom this property, the Acme Works, belonged. It was very unreasonable that creditors should be tied up, and unable to realise on judgments they had recovered.

Mr. JUSTICE CAVE: The receiving order seems a right order to make.

Mr. WILLS: I cannot say that the transaction which led up to it was a straightforward one.

Mr. JUSTICE CAVE: Then if it was not a straightforward one, you ought to go to Mr. Justice Wright to get it set right.

Mr. WILLS submitted that this Court had jurisdiction to deal with the matter. At the time when Mr. Justice Wright made the order appointing the receivers, Messrs. Bolton were applying for leave to interplead and have the ownership of the Acme Works determined. The Court ought now to order payment by the receiver within seven days, otherwise execution levied.

Mr. JUSTICE CAVE: Are you willing, Mr. Isaacs, to give the appellants a charge on the property?

Mr. ISAACS: Yes, we have always been willing to do that.

After some further discussion,

Mr. JUSTICE CAVE said the following order would be made by consent—the appellants to have a charge upon the monies, and the receivers to pass their accounts within a reasonable time. The appeal would be adjourned *sine die*, and costs reserved.

AT the Manchester Spring Assizes, in the Crown Court, before Mr. Justice Collins, without a jury, an action was brought by Henry Gartside, a brewer of Stalybridge, to recover from Arthur Shippey, an electrical engineer, of London, the sum of £56 10s., money advanced to him. The defendant conducted his own case in person. The money was advanced by the plaintiff in connection with a tramway brake he had patented, and also in connection with a company styled the Patent Combined Brake Starting Company, Limited, which they formed. Judgment was given in favour of the plaintiff.

REVIEWS.

William Gilbert, of Colchester, Physician, of London, on the Loadstone and Magnetic Bodies, and on the Great Magnet, the Earth. A translation by P. FLEURY MOTTELAY. London: Bernard Quaritch, 15, Piccadilly.

This book, the original of which is better known by the name *De Magnete*, has been a somewhat difficult task to produce, seeing that the translator had set to work to give a clear and competent presentation in idiomatic English and not simply a substitution of English words for Latin. In compiling the book Gilbert made use of many "words new and unheard of," besides attaching to many others a signification far different from that generally recognised at the present day; many uncouth words are met with, the exact meaning of which may be doubtful; the translator has, however, grappled with all difficulties of the kind, and has produced a translation which leaves little to be desired. Of the general contents of the book little need be said, but one is struck with the marvellous grasp which the author (Gilbert) had obtained of the subject he wrote about. A perusal of the work, while it will prove eminently entertaining, will also be found, in many ways, instructive.

Mr. Mottelay we should state is an American, which accounts for the slight slip which we notice in the biographical memoir, where it is stated that Gilbert's house in Colchester is situated between Knight Rider and Upper Thames Streets, these streets being, as a matter of fact, in London.

The Romance of Electricity. By JOHN MUNRO. Published by the Religious Tract Society.

When the author of this little book styled it "The Romance," he was undoubtedly *romancing*, but *only* then; for, beyond the mere misnaming, there is nothing sufficiently inactual to need a cloak of fiction to cover peccadillos. Mr. Munro's subjects, though "gay, glorious, and god-like," are facts rather than fancies, and therefore as remote from romance as is truth itself. Also, we would point out, that even the "The" of his title is somewhat misleading; it suggests a certain finality which does not yet belong to our acquaintance with electricity. Hence, we hope to have forgiveness if, by a slight inversion, we re-christen his work, "A Munroce of Electricity."

Between the realms of science and superstition is Nature's wonderland; that unexplored country from which science gathers her marvels, and superstition borrows its terrors. It is to this wonderland—the home of thunder, lightning, and auroræ, the world of sea-serpents, mock-turtles, mad-hatters, and mock-suns—that Mr. Munro invites his readers. He restricts himself to the scientific coasts, however, and leaves the rest to Lewis Carroll.

It is a book of some 300 pages. The greater part devoted to what we might term "geoelectric" phenomena. A most valuable collection of facts concerning the various observations which have been recorded of electrical discharges, occurring as lightning, fire-balls, &c., will be found full of interest to meteorologists. The mystery of the aurora is carefully discussed, though, of course, in a popular style, the instances given are really excellent and should be widely read. The history of man's acquaintance with the earth's magnetism occupies an important chapter. Another is given to the gymnotus and his kindred. The second part of the book deals more with developed science. Stories and facts relating to the telegraph and telephone, with glimpses of Crookes and Tesla, &c., followed by speculations about the future. Considering the force and scope of his theme—Nature at her very best—it is not to be wondered at that this book of Mr. Munro's gives some very delectable knowledge, serviceable both to men of science and to general readers, old and young. The inhospitable picture (p. 60), we trust will be deleted in future editions.

Electrical Measurements and other Advanced Primers of Electricity. By EDWIN J. HOUSTON, A.M. New York: the W. J. Johnston Company, Limited., 41, Park Row.

"Electrical Measurements and other Advanced Primers of Electricity" is the somewhat curious title of the second volume of Prof. Houston's series of elementary electrical treatises for students and non-technical readers. A third volume will complete the series, but each volume is complete in itself, as are the several primers in each volume, as far as possible.

The book derives its title from the first three primers, which are on the measurements of electric currents, electromotive forces, and resistances, respectively. The object of these primers is not so much to teach the practical operations of electrical measurements as to explain in simple but exact

terms the principles and apparatus upon which they are based.

Two primers are on voltaic and thermo-electric cells and other sources of electricity. The principles upon which commercial currents are based are explained in three primers, and nine others are devoted to the principles and applications of dynamos, motors, and transformers, the eighteenth and last primer being a review or primer of primers.

The book consists of 18 chapters, as follows:—I. The Measurement of Electric Currents. II. The Measurement of Electromotive Force. III. The Measurement of Electric Resistance. IV. Voltaic Cells. V. Thermo-electric Cells and other Electric Sources. VI. Distribution of Electricity by Direct or Continuous Currents. VII. Arc Lighting. VIII. Incandescent Electric Lighting. IX. Alternating Currents. X. Alternating Current Distribution. XI. Electric Currents of High Frequency. XII. Electro-Dynamic Induction. XIII. Induction Coils and Transformers. XIV. Dynamo-Electric Machines. XV. Electro-Dynamics. XVI. The Electric Motor. XVII. The Electric Transmission of Power. XVIII. Review—Primer of Primers.

A feature in each chapter is the addition at the end of each of an "Extract from Standard Works."

In some respects the book strikes one as being hardly elementary enough, *i.e.*, statements are made which would be almost, if not quite, incomprehensible to a student unless he possessed something more than an elementary knowledge of electrical science before reading the work. That the information and general design of the book is sound follows as a matter of course, the name of the author is a sufficient guarantee of that.

Electricity and Magnetism. By S. R. BOTTONE. Whittaker and Company and George Bell & Sons.

In every way a disappointing book. Its object, as stated in the preface, is "to present an easy and attractive introduction to the sciences of electricity and magnetism . . . to impart exact knowledge that will not have to be unlearnt." Perhaps the worst feature of this attempt at a scientific treatise is the hopeless confusion of terms, and the entanglement of theories. Thus, p. 76: "It is found that the tendency which electricity has to dissipate itself from any part of the surface of a charged body depends, to a great extent, on the distance of that part from the centre of mass of the body. If we agree to designate this tendency to escape by the term *electrical density*, or tension, we may state the same idea in other words by saying that points on the surface of a body which are at equal distances from the centre will have the same electric density, those which are farther from the centre will have greater, while those which are nearer to the centre will have less density, tension, or charge." This is sufficiently eloquent—there is more like it. The author devotes a good deal of space to the portative power of magnets. Here is an extract: "As the result of many experiments it has been found that detaching suddenly the keeper from a magnet diminishes its power." So popular delusion is transmitted through the race! Dr. S. P. Thompson, in his Cantor lectures of 1890, specified this fallacy, showing that the real cause of mischief was not the "pulling off" but the "slamming on." We heartily commend those lectures to Mr. Bottone; they will help him out of the difficulty he finds (p. 20), "to give a simple rule for calculating the maximum portative force which it is impossible (*sic*) to impart to a horse-shoe magnet." The formula we use is $\frac{K}{0}$, where K is a constant, depending on the credulity of the student. The author gives a bland statement of the classic formula of Häcker, its meaning is so extremely narrow that it would have been wisely left out. Antiquities of science are further represented by venerable forms of statical instruments designed to prove (very much *peradventure*) the law of inverse squares. The age has progressed, even in regard to laboratory and lecture room apparatus; a fact which seems to have been overlooked. A misprint which puts a "5" for a "50" in a denominator (p. 140) spoils one of the few numerical examples; and something of the same kind happens at p. 38, where in a *foot*note, appropriately enough, Mr. Bottone tells us that "a dry living cat rubbed over the surface while being held by her fore paws will be found very efficacious in exciting the electrophorous." A catalysis indeed!

Journal of the Institution of Electrical Engineers. Nos. 104, 105. London: E. & F. N. Spon, 125, Strand.

The general contents of these numbers are as follows: No. 104, Continuation of discussion on Dr. Fleming's paper on "Researches on Alternate-Current Transformers"; "On Testing and Working Alternators," by W. M. Mordey. No. 105, "Discussion on Mr. Mordey's paper; "A New Form of Portable Photometer," by Sir David Salomons; "Earth Currents in India," by E. O. Walker; "Notes on the Influence of Electricity in Tanning Operations," by C. K. Falkenstein. The index to Vol. xxi. and a revised list of members has also been issued.

Electric Lighting and Power Distribution. Part II. By W. PERREN MAYCOCK, M.I.E.E. London: Whittaker & Co.

This work is an example of a class of books now so plentifully supplied and offered to students, who, taking up this book will find that it attempts to describe dynamos, alternators, and electric lamps, arc and incandescent, in 130 pages. The continuous current dynamo occupies the first 30 pages, and is illustrated by no less than 15 dynamos all of the same kind; for the purposes of the student these pages would have been much better occupied by a full, clear, and simple discussion of dynamo machine design, taking any one of the 15 as an example. With the fifteen illustrations only a short description is found, such as is usually given in the manufacturer's catalogue. To the student no information is offered regarding the reasons why one dynamo differs in appearance from another; he should have been informed that the difference between one good dynamo and another is exceedingly small, consisting principally in unimportant details, and that if he thoroughly mastered the design of any one, he could understand any other design.

Chapter VIII. describes very briefly, without going into details of design, a few alternators, and like the previous chapter, is overcrowded with very familiar illustrations not very instructive to the student; we have previously had many classifications of alternators; in this work they are classified according to the method of excitation of the field magnets, and referring to the magneto alternator, the student is informed that this class is obsolete; this hardly agrees with the fact that all the large lighthouses in the world are fitted out with magnetos of M. de Meritens's make. The magneto alternators still hold a very important position, and are always instructive machines to consider.

Chapter IX. deals with continuous current motors, and is more educational, as it will be of use to a student. Chapter X., on characteristic curves, is also of value. Both these chapters contain good diagrams and simple explanations.

In describing the construction of incandescent lamps, only the leading processes are given, the important details upon which lamp-making depends for success are not shown; the student should have been informed that flashing is always performed in a partial vacuum of hydrocarbon, and also how the beautiful joint between platinum and carbon is made electrically in a hydrocarbon liquid.

The concluding chapter deals with arc lamps. This subject is a difficult one to handle, and this author, like almost every other when attempting to treat it for students, begins unfortunately and ends in confusion; he starts with a differential lamp, in which the main and shunt coils form one solenoid acting on one core of iron, illustrated by a diagram of an impossible arc lamp. If the student accepts this as the ideal of the differential principle in arc lamps, he will be very much astray.

This is only one form of differential arrangement, and the worst possible form in practice; the best form and the one to be impressed on the student's mind has separate shunt and main solenoids acting on separate cores or on opposite ends of the same core. There is little or no instruction whatever to be obtained from this chapter, on arc lamps in general, although two or three in particular are illustrated and described.

The book forms one of a series, and is not quite so useful as the previous one. This may be accounted for by the fact that the subjects now treated demand more practical knowledge and experience than scientific and book knowledge. Dynamos, alternators, arc lamps and glow lamps, as now constructed, are subjects which require a thorough practical

knowledge on the part of any author attempting to write for the student. In this work as in nearly all the elementary works now so numerous, the information regarding these machines and appliances is evidently taken from manufacturers and others, and given, without digestion, to the learner.

Alternating Currents of Electricity. By GISBERT KAPP. New York: W. J. Johnstone Company.

This work is a reprint of Mr. Kapp's lectures before the Royal Engineers, with an introduction by Mr. Stanley, jun. It forms an excellent elementary treatise on alternating currents; in fact, we may say that it is the best thing of the kind we have seen. It presents the subject in a simple manner, easily followed by anyone having the most elementary knowledge. It begins with the measurement of alternating currents and pressures; this is followed by a thoroughly practical treatment of alternators, with a few diagrams of the most advanced designs. Transformers are next treated in a manner so clear and simple, that the reader must form correct ideas regarding the transformer.

Multiphase motors are also discussed in the same way. The illustrations are limited throughout this book, but these are very instructive; a few mathematical formulæ are given in appendices.

This work would form an excellent one to begin with in the study of alternating currents in their practical applications.

The introduction might very well have been replaced by a preface, written by the author of the lectures. The introduction is, in other words, a review of the lectures as they now appear in book form.

NOTES.

The Telephone Question.—"Our contemporary, with conspicuous ability, refuses to come to close quarters, or to prove its assertions." So says the *Electrical Engineer* in a further article on the telephone question. As no new points are raised, we can leave our readers to form their own opinions.

Obituary.—We much regret to have to record the death of a well known figure in the Continental electrical world, M. Frank Geraldy. M. Geraldy was for a long period, and to the day of his death, an editor of *La Lumière Electrique*, and that periodical has owed much, we believe, to his editorial talents. He was born in 1838, and was, therefore, 55 years of age at his death. His father was President of the Caen Court of Appeal. At the age of 22 M. Geraldy became a "Ponts-et-Chaussées" engineer, in which capacity he did excellent work, having amongst other things constructed the famous "Barrage de l'Orne." The part which he took in this undertaking brought him into contact with M. Du Moncel, and as a result he devoted himself to scientific work, with which his life has been closely identified. When electrical science came to the fore, Geraldy energetically devoted his talents in this direction, and as the writer of numerous articles, characterised by decided originality, logical soundness, and grasp of detail, he will long be remembered.

It is our sad duty to record that on May 1st, at Salina Cruz, Mexico, James Ford Lumsden was drowned by the upsetting of a boat while landing the shore end of a cable from the ss. *Silvertown*, and that one of the cable hands unfortunately shared the same fate. Mr. Lumsden, who was the eldest son of the well-known Superintendent of the Submarine Department of the General Post Office, had only attained his 24th year, and his untimely end is a great loss in every way. He was always ready to work in the face of any difficulties; cheerful, strong, active, a capital shot, an excellent boxer, a good boating man, football player and cricketer; he was also regarded as an all-round athlete. He was deservedly an universal favourite, and had served on both the engineering and electrical staff of the Silvertown Company, giving great satisfaction in both branches, and showing every promise of future excellence in his profession.

Within a few months have passed away quite a number of pioneers of telegraphy whom the world could ill afford to spare, among them being such men as Cyrus Field, Neilsen, Gisborne, Cracknell, and Norvin Green. The latest loss sustained is by a death which we record with feelings of the deepest regret, and which has happened in our own country. Sir James Anderson, whose illness had been spoken of for but a few weeks, died early on Sunday morning, May 7th, at his residence in Queen's Gate, in his 69th year. It is needless to refer in detail to the numerous honours and orders conferred upon Sir James both at home and abroad. His superintendence of the expedition for laying the Atlantic cables of 1865 and 1866, and his arduous labours connected therewith, gained for him his knighthood. Sir James was very widely known in both telegraphic and electrical circles, and was one of the first authorities on cable matters. He was the writer of a number of papers on telegraphic subjects, and a book on "Statistics of Telegraphy," and also entered laboriously upon the task of the compilation of telegraph codes, in fact, it is largely due to his work in this direction that such codes are now so extensively used. He was a Fellow of the Royal Geographical, Geological, and Statistical Societies, a Member of the Institution of Electrical Engineers, and of the Imperial and other institutions. Sir James represented the Eastern and other Telegraph Companies at all the International Telegraph Conferences since that held at Rome in 1871, viz.:—St. Petersburg 1875, London 1879, Berlin 1885, and Paris 1890. He was connected with many of the great telegraph companies, and was a well known, regular, homely and happy figure at the various meetings of the companies; his welcome presence will be very sadly missed at these gatherings; his absence will be strongly felt by directors, shareholders, and press representatives. The directors of the 12 undertakings with which he was recognised, cannot fail to experience the great loss sustained by the death of such an old friend and colleague as Sir James. He will be specially remembered for his remarkable personal kindness to the employés in the different companies, also for his charity, as he subscribed to an immense number of benevolent and charitable institutions.

Blackpool Electric Lighting.—Mr. William Chew, electrical engineer, has just presented his thirteenth annual report of the working of the electric light stations, No. 1 and No. 2, which have remained under his charge, to the Markets and Gas Committee as follows:—"I have to report that the plant has been kept running during the year, and working at its normal capacity. The manufacturing appliances have been maintained in good condition. The principal items of renewals have consisted of switches, armatures, lamps and lanterns, whilst the boilers have had several new tubes reinstated therein. The distributing plant is in need of repair, to make it efficient for the coming year. The working expenses, I am pleased to say, have not reached the estimated cost, and there will be a moderate surplus of about £70 to the good. As we have for many years worked with a closed capital account, and no new work has this year been undertaken, we may take the working cost as that of an average year, and on this basis arrive at the cost of our supply per Board of Trade unit, which is the standard of price. I have made an analysis of our cost, on the same lines as that adopted by the new central stations that are now at work in the country. Taking the returns for 1892 of the nine leading London and provincial concerns, I find the highest cost per unit for working is 8·92d. per unit, the lowest is 3·43d., whilst the average is 4·81d.; to this must be added, for dividend, &c., from 1s. 3d. to three half-pence. The cost of our supply was 4·46d., but is subject to a further reduction of a penny per unit from sundry receipts, making the net cost to the Corporation of 3·46d. per unit for the electricity supplied to the lamps. Turning to the relative demand of private to public lighting, the number of private lights in use is 18 per cent. of the total, whilst the private consumption is only 5·25 per cent. of the year's output. The relative demand in June is one-third that in December, there being little private lighting in December. The output of a large town in our neighbourhood in June is just one-eighth that in January."

Dorchester Electric Lighting.—The Town Council has decided to obtain the advice of Messrs. Newton, electrical engineers, of Taunton, as to the necessary alterations and costs requisite for providing the town with electric lighting.

What Causes the Depression in the Coal Trade?—In a letter on the depression in the coal trade, "Engineer," in the *Newcastle Daily Chronicle*, asserts that one of the most potent factors causing a permanent falling off in the demand for coal is the progress of electric lighting. It is a recognised fact that the lower the coal consumption at central stations the more rejoicing is there among directors and shareholders, or corporations and their engineers.

Royal Society Conversazione.—The annual *conversazione* of the Royal Society was held at Burlington House on Wednesday last, May 10th. The electrical developments of the year were well represented, notably, perhaps, by the exhibits of the Rev. F. J. Smith, M.A., Prof. Ewing, Major Holden, Sir David Salomons, and Mr. Swinton. We reserve till next week a fuller account of this meeting.

Underground Telephone Wires in Manchester.—The Paving Committee of the Manchester Town Council have instructed the Town Clerk, City Surveyor, and Dr. John Hopkinson to prepare a report upon the subject of underground telephone wires. The Council at their last week's meeting did not confirm the committee's minute to this effect. The question is, therefore, in abeyance at the moment, but within a week or two, it seems, the matter will come up again and be thoroughly considered.

Profits on Electrical Business in America.—The first annual report of the directors of the New York General Electric Company shows the profit from the company's business for the eight months ending January 31st, 1893, over and above all expenses, deductions for bad debts, &c., as $3,356,593.10. After paying dividends on the common and deferred stocks and allowing for interests and other items, there remains a surplus to be carried forward of $1,024,954.59. The company was incorporated on April 22nd last year, and commenced active business on June 1st. This result must be regarded as by no means unsatisfactory, so far as the General Electric Company itself is concerned.

Electric Bicycles.—We are again threatened with a revival of the electric bicycle. Many inventors seem to consider the idea a novelty and the outcome of their genius as a commercial article. It is difficult to understand how anyone can be so deluded as to spend time and money in the vain hope of doing something with primary or secondary batteries, and a vehicle which is part cycle, part cabriolet, and part goods waggon with a perambulating accumulator house and switchboard as an ornamental feature. The spread of up-to-date information should save the would-be inventors of such combinations the disappointment which is sure to dog their footsteps if they persist in pushing the electro-cycle in face of an unwilling market. The latest in this direction is to be run by batteries weighing over 40 lbs., and having a total weight of between 150 and 160 lbs., but, as might be expected, no data are given of distance run or speed obtained by the aid of such a contrivance.

Failure of the Electric Light at the House of Commons.—A sudden extinction of the electric light occurred in the House of Commons on Monday night. There was no inconvenience caused in the House itself, as it is still illuminated by gas; but the numerous ante-rooms, lobbies and corridors were suddenly plunged into darkness for a quarter of an hour, when lamps and candles were brought, and even ginger-beer bottles were used as candlesticks, which will illustrate to some extent the state of confusion. The *Daily News*, commenting on the subject, attributes the cause of the failure to the supply furnished by the Electric Supply Company. This, however, is not correct, as the extinction was due to the melting of a fuse in the House itself, beyond the control of the Westminster Electric Supply Corporation, who furnish the current. There is, therefore, no blame whatever attachable to the corporation for the failure.

The City Electric Lighting.—The City Commissioners have decided to permit the City of London Electric Lighting Company to carry their mains and tubes over London Bridge. The work will be done in sections, so as to, as far as possible, avoid inconvenience to traffic.

Edinburgh Electric Lighting.—The ratepayers of Edinburgh are doing their utmost in the way of expressing disapproval of the Town Council's decision to take the electric lighting of the town into their own hands, and carry the work out themselves. A public meeting of the electors of the Carlton Ward was held last Friday, when the subject was discussed. At their meeting on 2nd inst. the Council reaffirmed their decision to take over the management of the electric lighting by a majority of 3. The voting was 19 to 16.

Kidderminster Electric Lighting.—With reference to our note on this subject last week, we learn that the expert engaged by the Law Committee was Mr. A. Bromley Holmes. His report recommended the low tension system. He estimates the cost of laying mains, erecting buildings, and putting down plant capable of supplying 3,000 16-C.P. incandescent lamps, the buildings being so arranged as to admit of extension, at £15,000. As the price of gas at Kidderminster is low, Mr. Holmes does not anticipate that there will at first be a large demand for the light. The committee are sending out circulars to ascertain the probable number of users, and will report further on the subject later.

Private Bills in Parliament.—The Standing Orders Committee of the House of Lords has decided to dispense with the standing orders in the case of the Hampstead, St. Pancras and Charing Cross Railway. All opposition to this Bill in the House of Lords has been withdrawn.

An order of the Board of Trade, placing the electric lighting of the Beckenham district in the hands of the Local Board, has passed the examiner on standing orders.

In the House of Lords, on Monday last, the Kensington and Knightsbridge Electric Lighting Company's Bill was read a third time and passed.

At a meeting of the House of Lords Committee, on 8th inst., the Examiner held that the petition for a Bill by the City of London Electric Lighting Company, for the amalgamation of the undertaking for lighting the City, had not complied with the standing orders. The Brighton and Rottingdean Seashore Electric Railway Bill passed the Examiner.

The Marseilles-Oran Cable.—Volume XX. of the *Annales Telegraphiques* contains a short account of the manufacture and laying of the above cable, from the pen of Mr. E. Wünschendorff, Chief of the French Telegraphs. The contract was given to the Société Générale des Téléphones on August 27th, 1891, and the cable was opened to the public on September 7th, 1892. Its length is 592·6 N.M. Interesting details are given of the determination of a new table of temperature corrections for the special gutta-percha which was employed. The core was composed of 107 lbs. copper and 140 lbs. gutta-percha per. N.M. The mean C.R. per N.M. was 11·181 ohms, the G.P.R. was 1,357 megohms per N.M. at 75° F., and the mean electrostatic capacity 0·306 mfs. per N.M. The total length of cable manufactured was 631 N.M. The shore end was landed at Oran on August 24th, 1892, and after some 12 miles had been laid, the end was buoyed in 250 fathoms. The *François Arago* then sounded towards Marseilles, taking 55 soundings without a single breakage of the wire. The laying of the cable was begun from Marseilles on August 30th, and completed without any incident on September 3rd. The average amount of slack was 8·4 per cent. Comparisons are given between the electrification of the laid cable and that between Marseilles and Algiers of 1880. Mr. Wünschendorff concludes with the remark that the way in which the contract was carried out does equal credit to the directors of the Société, and to the engineers and electricians, Mr. Seaton, chief of the expedition, Messrs. Smith, Stallibrass, Rouilliard, Sullivan, Fournier, Coquille, and the commander of the *François Arago*, M. Bonnaud. After six months' guarantee, the cable was accepted by the French Government *sans reserve*.

Electrocution.—A Reuter's telegram, dated New York, May 8th, states that a medical student was executed there on that day by electricity in Sing Sing prison. The student, whose name was Carlyle Harris, was recently convicted of having caused the death of his wife, aged 17 years, who died from the effects of poisoning at the boarding school where she was being educated.

Long Distance Telephony in America.—According to to a Dalziel telegram, dated May 4th, from Ottawa, the Automatic Telephone Company of Canada, which has just been incorporated, proposes to run a copper metallic trunk line direct from Halifax to Vancouver, a distance of 3,500 miles. Local plant will be established at the towns between the termini.

Portrush Electric Lighting.—The Town Commissioners last week considered a report by Mr. H. W. Blake electrical engineer, on the proposed electric lighting scheme. After a lengthy discussion it was resolved to appoint a committee to ascertain the probable number of users of the light in the event of it being installed, before applying for a loan for carrying out the work.

Brisbane Electric Lighting.—At a recent meeting of the South Brisbane Municipal Council on a letter being read from the contractors, Messrs. Trackson Bros., asking for an extension of time for completing the electric lighting of the borough, there was a considerable amount of discussion, and it was ultimately decided to prepare specifications and ask for fresh tenders for lighting the borough by electricity or otherwise.

The City Electric Lighting Company's Bill.—The *London Gazette* of last week contained notification of application being made to Parliament by the City of London Electric Lighting Company, Limited, for a Bill granting certain provisions affecting amounts and depreciation funds and amendments of City of London Electric Lighting (Brush) Order, 1890, and City of London (East District) Electric Lighting Order, 1890, and City of London Electric Lighting (Brush) Order, 1891; exemption of generating stations from Metropolitan Building Act, 1855; amendment of Acts, &c.

The E.M.F. of Secondary Cells.—A communication to the Physical Society, by Dr. Gladstone and Mr. W. Hibbert, includes replies to certain questions raised by M. Darriens in in a paper read before the Societé Internationale des Electriciens, and to views expressed by Prof. Armstrong and Mr. Robertson. M. Darriens agrees with Prof. Armstrong and Mr. Robertson, that the large E.M.F. immediately after charge is due to persulphuric acid, and opposes the ordinary theory that the ultimate product of discharge is lead sulphate at both plates, so far as the positive plate is concerned. The authors conclude that the changes of E.M.F. during charge and discharge depend on the strength of the acid that is against the working surfaces of the plates. Other important questions are discussed, for an account of which we must refer our readers to the paper itself.

Bury Electric Lighting.—The Electric Lighting Committee have presented the report of their visit to London and other towns. They recommend that the borough engineer be instructed to prepare conditions upon which a number of contractors should be asked for tenders, the engineer to have power to adopt and recommend such systems of supply, and types of motive power and dynamos, as they may deem best suited to meet these conditions, also that they be empowered to engage a consulting electrical engineer, to act in conjunction with the borough engineer, to advise the committee as to which tender meets the conditions, and afterwards to prepare such further drawings, estimates, and specifications as may be necessary. This has been agreed to.

Hampstead Electric Lighting.—The Vestry have adopted the specification prepared by Mr. Preece for the plant, &c., required for the proposed central station at Hampstead. They have also resolved to advertise for tenders for the necessary plant, buildings, &c. Application is to be made to the London County Council for permission to borrow £25,000.

Manchester Electric Lighting.—The works for lighting the central portion of the city by electricity are now approaching completion. It has been decided to formally open and put the station in operation on August 1st.

A Newspaper for Technology.—The advance of technical education has brought into existence a new journal, as a medium for official reports and announcements, and as a guide to the developments of the various technological efforts at home and abroad. Hitherto the electrical press have done their share of this work, arising, in part, perhaps, from the fact that the first technical school in London was so distinctly electrical. Many of the earlier and later problems have been fought out in our pages, and we have more to follow. Meanwhile, we welcome the intruder, and wish it every success. It is styled the *Technical World*, and its *locus* is 14, Langham Place.

Liverpool Overhead Railway.—The Electric Construction Corporation have had bound in catalogue forma short description of the Liverpool Overhead Railway. There arenine pages of very fair illustrations, the greater part of the remainder of the pamphlet being devoted to a lengthy account of the trial trip by the directors of the railway, on January 7th last. The illustrations are nearly all the same as appeared in the technical journals a few months ago.

Canongate Electric Lighting.—A requisition, largely signed by electors in the Canongate Ward, has been presented to the ward representatives, desiring them to call a public meeting to consider the question of electric lighting.

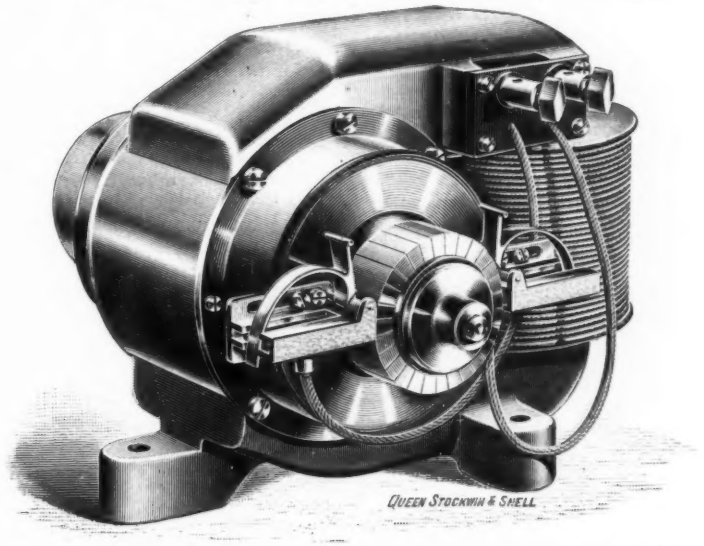
Exeter Electric Lighting.—The Streets' Committee of the Exeter Town Council have had under consideration a letter from the secretary to the Exeter Electric Light Company with regard to the charge for supervision in connection with laying the underground cables of the company. It was agreed that a charge of 5 per cent. upon the outlay be made to defray the cost of supervision incurred by the council.

Newport Electric Lighting.—Prof. Robinson, of King's College, has been called in to advise the Newport Corporation as to lighting the thoroughfares by electricity. The cost of the installation in the six principal streets in the centre of the town is estimated to be £30,560; and the annual cost of maintenance would be £5,650. For this sum 4,500 lamps of 16-candle power could be provided.

Electricity on the Farm.—An interesting example of electricity as applied to farm work has been in operation for some time at Ardwell, Wigtonshire, the property of Mrs. Ommaney McTaggart. The whole of the usual farm machinery, such as threshing, sawing, corn-crushing, and the like, are here driven by an electric motor. The electricity is generated by water power, the turbine wheel which drives the dynamo being about 1,000 yards from the farm. The electric current is conveyed by underground wires to the house and farm, in each of which a storage battery is placed; these supply the electric current for lighting and motive purposes when the machinery is not working. The whole of the mansion is lit with the electric light, and an electric motor is provided for pumping water for domestic purposes. At the farm, which is also lit throughout with the electric light, there is a larger electric motor of 16 horse-power, which is arranged to drive the farm machinery. This it does quite easily. This motor runs remarkably smoothly and quietly. It requires no governor, as the speed does not vary whatever the load may be. This is especially noticeable when sawing, the power required for which is constantly altering. Another feature of interest is the ease and quickness in starting. There is no waiting to get up steam, as the motor is at once started by moving over the switch handle. There are many places where water power now running to waste could be utilised in a similar manner. When the distance is great, it would be advisable to run the wires on poles overhead. The above work has been carried out by Mr. R. Frederick Yorke, A.I.E.E., electrical engineer, of Glasgow, under the instructions of Sir Mark Stewart, Bart., M.P., of Southwick.

BUSINESS NOTICES, &c.

The "Domestic" Motor.—This motor, since its introduction, has undergone some very important improvements. The rollers now are kept from coming into contact with each other by a ring with studs, set equal distance apart. The rollers have each a hole in the centre made to fit the studs easily. By this means the rollers are prevented from touching each other at the sides. This reduces the friction to a minimum, and also makes the operation of taking the bearings apart and fixing together again much easier. The brush-holders are another important feature in this machine. These are made so certain in their action, and so simple to manipulate, that a child can replace a new brush equally as well as a grown up person. Once a pair of brushes are put in, no further attention is necessary until they are worn entirely away, when all that is necessary to do is to lift the feeder and insert a new one at the back. This can be done without stopping the motor for a moment. The brushes do not require trimming. The feeders are so formed that they keep up a perfectly even and constant pressure on the brushes. As will be seen from the illustration the machine is compact and has a neat appearance. The front shields and the roller cases are made of gunmetal. The motor is supplied by Messrs. Austin & Myers, of Armley, Leeds.



Batavia Exhibition.—Messrs. John Birch & Co., of Queen Street Place, E.C., write us as follows:—"The last inward mail has brought us an intimation from the Committee of the Foreign Section that they will be glad to receive photographs of all descriptions of machinery and mnnufactures of a kind likely to be suitable and interesting in the colony, and they will also be pleased to have catalogues from manufacturers for distribution. We will be only too glad to give any further information to firms or persons desirous of taking advantage of the above; but communications on the subject should be addressed to us as quickly as possible, seeing that the exhibition opens on August 1st, and that the last exhibits must leave here not later than a month from now. We have undertaken the electric lighting of the main portion of the exhibition, and as we are sending out attendants, we will be very willing to give assistance in the distribution of catalogues, &c., to any who wish to take advantage of the above invitation."

Burnopfield Co-operative Society.—Messrs. Ernest Scott & Mountain have secured the contract for the electric lighting of the Burnopfield Co-operative Society's premises at Burnopfield. This installation will be driven from a 7 horse-power nominal Priestman oil engine, which was fixed a short time since with a view of being utilised for working the electric light as well as driving the hoist. The installation will consist of one of Messrs. Scott and Mountain's improved Tyne dynamos, capable of running 100 16-C.P. incandescent lamps, with accumulators, and about 100 16-C.P. lamps fixed throughout the premises. Messrs. Scott & Mountain have already executed a considerable amount of work for the various co-operative societies, and have recently completed a large installation for the Co-operative Wholesale Society at Newcastle-on-Tyne, and also lighted the Dunston Flour Mill, and the Co-operative Stores in Newgate Street, Newcastle-on-Tyne.

Cathcart, Peto & Radford.—This firm have the following contracts in hand:—Installation of dynamo, storage cells, and 100 lights, at Thrift's Wholesale Grocery Warehouse, Croydon: fitting up of the Prince of Wales Club, Coventry Street, Piccadilly, for electric lighting; also the fitting up of 5 and 6, Throgmorton Street, and Dr. Waughs's premises at Finsbury Pavement. The same firm have also the contract for installing two dynamos and 100 lights in Messrs. Carbutt's Mills, Bermondsey.

Colliery Electric Lighting.—Messrs. R. Evans & Co., of Haydock, near St. Helens, who have already installed several of their collieries with the electric light, have lately put down a set of plant at another of their pits for lighting the pit's brow, engine house, also the shaft, which is being stripped and sunk deeper. The work has been carried out by their electrician, Mr. Goodare.

London Metallurgical Company, Limited.—At a meeting of this company held at 80, Turnmill Street on May 5th, the following resolutions were passed: "That it has been proved to the satisfaction of the members of the company that the company, by reason of its liabilities, cannot continue its business, and it is advisable to wind up the same, and that the company be wound up voluntarily accordingly. That Captain Sir Baldwin Wake Walker, Bart., and Mr. Thomas Rawlins, of 45, King William Street, London, E.C., be and they hereby are appointed joint liquidators for the purpose of such winding up." The *London Gazette* contains an announcement to the effect that a petition was presented in the High Court of Justice on May 6th by Charles Arthur Reeve, a creditor of the company. The petition is to be heard before Mr. Justice Vaughan Williams on 17th inst. All persons desirous of attending to support or oppose the said petition must give notice to W. R. Grant, solicitor, 41, Norfolk Street, Strand, W.C., by 16th inst.

Electricity the Light of to-day.—We have received a really beautiful book bearing the above title from Messrs. Sharp and Kent. It is merely intended to represent, in a pictorial form, to those requiring the electric light in their houses, a few of the many ways of adapting it. The eight coloured page illustrations are perfect works of art, and to several of them are added appropriate inscriptions from the works of Oliver Wendell Holmes, Lord Bacon, and Longfellow. The numerous photo-process blocks of electric lamps and fittings are also beautifully done, and we can certainly credit Messrs. Sharp & Kent with the most artistic trade production yet brought before our notice.

Electric Light Tenders.—At a meeting of the lighting and electrical committee of the Cardiff County Council, held on Monday, it was stated that the following tenders were received for the erection of the first portion of the electric lighting station at Canton:—

Frank Ashley, Cardiff	£4,272	4	4
W. Thomas & Co., Cardiff	£3,328	3	2
T. D. Ridley, Cardiff	£3,234	10	6
Ellis & Davies, Cardiff	£3,254	17	7

It was recommended that the tender of Messrs. Thomas & Co. be accepted.

Electric Cranes at Southampton.—In regard to our notice on this subject last week, in which we refer to the testing of the crane at Messrs. Stothert & Pitt's works at Bath, we are asked, in order to avoid misunderstanding, to state that the contract for this crane was placed with Messrs. J. G. Statter & Co., by the Southampton Harbour Board, and that all the electrical work in connection with same is being carried out by them; the remaining portion of the work was placed by Messrs. Statter in the hands of Messrs. Stothert & Pitt, with whom the former firm are working in conjunction in the matter.

Imperial Institute.—The electrical apparatus whereby electrical communication was made with the belfry to start the peal of bells, was designed and erected by Messrs. Julius Sax & Co., Limited, under the personal supervision of Alfred Slatter, their manager. The electric lighting of the Queen's lift, and complete telephonic and bell communication throughout the building, was also carried out by the same firm.

Bristol Electric Lighting.—We understand that it is recommended that the authorities accept the tender of the Brush Company for the supply and erection of transformers, terminal boards, &c., at the various sub-stations at £1,752, and that of Mr. F M. Newton for the supply and erection of switchboards, storage battery, &c., at the central station at £1,553 10s.

Bankruptcy Notice.—At the Bristol Bankruptcy Court last week, Stanton Drew, lately carrying on business at 25, St. Stephen Street, Bristol, as an India-rubber merchant and electrician, was adjudicated bankrupt, and Mr. E. T. Munden was appointed trustee. The liabilities amounted to £722 and the deficiency to £317. Want of capital and bad trade were the alleged causes of failure.

Change of Address.—Messrs. McClellan & Co. announce that, owing to increase of business in their various departments, it has become necessary to remove to more convenient and commodious premises at 35, Ludgate Hill, where all future communications should be addressed. Mr. W. S. Newbould, who has for over 10 years taken an active part in the business of Messrs. Woodhouse & Rawson, electrical engineers, has joined the firm with a view to extending the different branches.

Middlesborough Electric Lighting.—Several firms have been invited to tender for the necessary work connected with the fitting up of the municipal buildings and town hall by electricity. The firms asked are Mr. Jno. Stevenson, Mr. Bigge, of Selby, Bigge and Co., and Messrs. J. H. Holmes.

Presentation.—On Monday night, at the offices of the National Telephone Company, Dundee, Mr. J. D. Miller, M.I.E.E., was presented by the *employés* with a handsome timepiece, on the occasion of his leaving Dundee for Edinburgh district, to which he has been appointed.

Sheffield Telephone Exchange and Electric Light Company, Limited.—A general meeting of this company is to be held at the office of the company, Commercial Street, Sheffield, on June 12th, at 11 o'clock, for the purpose of having an account of the winding up of the company laid before the members.

Sale by Auction.—On Tuesday, 30th inst., will commence the sale by auction of the whole plant, material, tools, and stock, of the Woodside Electric Company. Further particulars will be found among our advertisements.

Saxby & Farmer, Limited.—The firm of Saxby and Farmer has been formed into a limited liability company, the whole of the capital having been privately subscribed. The registered office is at Canterbury Road, Kilburn, as before.

Private Electric Lighting.—Ferry Lodge, Wargrave, is about to be lighted with the electric light. The contract has been given to Messrs. Laing, Wharton, and Down.

CITY NOTES.

The Western and Brazilian Telegraph Company, Limited.

THE directors' report, presented at the twenty-fifth ordinary general meeting of the company, held yesterday at Winchester House, reads as follows:—

"The directors submit their report and the accounts of the company for the half-year ended December 31st, 1892. The total earnings amount to £86,954 11s. 2d., as against £92,345 4s. 7d., showing a decrease of £5,390 13s. 5d. compared with the half-year to December 31st, 1891. The working expenses amount to £37,165 11s. 5d. as against £38,404 5s. 1d., a decrease of £1,238 13s. 8d. Including the amount brought forward from June 30th, 1892 (£1,662 5s. 3d.), and the dividend received upon the shares held in the "Platino" Company, the balance to the credit of the revenue account is £58,838 5s., from which has been deducted £12,426 for debenture interest, and £6,674 for the debenture redemption fund, leaving £39,738 5s., of which £15,000 has been placed to the reserve fund. The directors now recommend the payment of a dividend of 4s. 6d. per share, free of income tax, for the half-year on the ordinary shares, making with the dividend paid in November last, £2 10s. per cent. for the year, leaving a balance of £2,829 15s. 6d. to be carried forward. In the case of shares which have been divided into "preferred" and "deferred," the 4s. 6d. per share now recommended will be payable to the "preferred" shareholders, making up the full dividend on the preferred shares for the year 1892. The fourth annual drawing of the A and B debentures took place at the company's offices on January 16th last, in the presence of Mr. W. W. Venn, jun., notary, when debentures amounting to £13,300 were drawn, and have since been paid off at par. The company's new repairing steamer frequently referred to has left for her station on the coast of South America. The duplication of the cables over the greater part of the system renders it feasible, in the opinion of the directors, satisfactorily to maintain the cables with only one repairing steamer, and consequently tentative measures are being taken with this object. The new cable *via* French Senegambia was opened for traffic on October 5th last, and was in active competition with the old system from that date until December 27th, when it became interrupted. It was repaired on February 9th of this year. A further reduction in the tariff for messages exchanged with Brazil, Uruguay, and the River Plate, came into operation on April 1st last. The land line connecting Buenos Ayres with Valparaiso, regarding which the shareholders have already been informed, is approaching completion, and the directors are given to understand will be in operation about the end of June next. The dividend warrants will be posted on May 12th, 1893. The retiring directors are Mr. W. S. Andrews and Mr. J. Coppen, who offer themselves for re-election. The auditors, Messrs. Turquand, Youngs, Weise, Bishop and Clarke, and Messrs. Deloitte, Dever, Griffiths and Co., retire and are eligible for re-election."

At the meeting yesterday Mr. W. S. Andrews presided.

The SECRETARY (Mr. R. M. Cunningham) having read the notice convening the meeting, also the minutes of the previous meeting,

The CHAIRMAN, in moving the adoption of the report and accounts, referred to the death of a leading man in the telegraph world, *i.e.*, Sir James Anderson, also to the illness of Mr. J. Coppen, a director, which had necessitated his going abroad for a short time. For the last half of 1892, the income was £86,954 against £92,345 for the corresponding half-year of 1891, a decrease of £5,390 on the six months. Considering the depression of commercial affairs in all the States of South America, the condition of the Exchange, and the additional competition that they had been subjected to from October 5th to December 27th, the figures on the whole were really more satisfactory than they could have anticipated. On the side of the expenses there was a certain feature of encouragement, namely, that on the whole there was a reduction, owing partly to exceptional causes. They amounted to £37,165 against £38,404, so that there was a decrease under that head of £1,238. That was made up of a great many figures. He then referred to the various increases and decreases under the several headings. After paying all these expenses, debenture interest, &c., and placing £15,000 to the reserve fund, there remained £24,738, and they proposed recommending a dividend of 1½ per cent. for the half-year, on the ordinary shares, making 2½ per cent. for the year. After paying that, there remained a balance to carry forward of £2,829. They had reached an important period in the history of the concern. They had been aiming at particular things. They aimed at the duplication of their system from Pernambuco to Buenos Ayres, and had succeeded in getting that done. That was a necessary preliminary to getting rid, as they hoped to do, of one of the repairing ships, and of the consequent expenses. They had recovered all the cable that they had before in deep water, and saw their way to ordering that new ship that they had just sent out. She had been built upon the best lines with the highest speed, good working capacity, and they hoped she would enable them to work the system in that respect more economically. After some further lengthy remarks regarding their ships he said that they had told the shareholders that if the revenue continued fairly satisfactory, and especially if the exchange were good, they would be able to meet their liabilities without issuing any debentures. So far they had been enabled to do that. The circumstances, however, had not been very good, neither had the exchange. Some gentlemen would look particularly at the item of £15,000 placed to reserve. In this case they were compelled to put that amount there on account of the looping policy and the ships policy, and it was the carrying out of those which had required the money. They had scraped through, nothwithstanding the fact that the conditions had not been as good as was anticipated. After speaking of the competition they had to contend with, he said he thought they had done very well under the circumstances. If the exchange were only fairly favourable, they would be enabled to pay the dividend which they had recently paid. Having made some lengthy comments regarding the state of affairs in South America, he moved the adoption of the report and accounts and declaration of the dividend.

The motion was seconded by C. W. EARLE.

A few remarks having been addressed to the board by Messrs. CLARKE, GRIFFITHS, PETO and others, and answered by the CHAIRMAN, the motion was put to the meeting and carried unanimously.

The retiring directors (Mr. W. S. Andrews and Mr. J. Coppen) having been re-elected, also the auditors,

A vote of thanks to the directors, &c., was acknowledged, and the meeting closed.

Elmore's French Patent Depositing Company.

THE extraordinary meeting, adjourned from April 6th, was held on Monday.

Major JONES, who presided, said the object of the adjournment was to enable Mr. Duncan, the receiver and manager who had been put in, to carry out negotiations with M. Secretan with a view to coming to an arrangement for the sale of the business to a French company, the scheme for which was foreshadowed at that meeting, and which was generally approved. Mr. Duncan had so far carried the scheme through, that he had come to a provisional agreement with M. Secretan for the sale of the business. This provisional agreement had been signed and sealed by the board of the French Company, the Foreign and Colonial Company, and by M. Secretan, subject, of course, to the approval of the shareholders and of the Court. Before proceeding further with the motion for the voluntary liquidation, he (the chairman) thought it advisable that the translation of the agreement should be read.

The SECRETARY then read the agreement made between Mr. Duncan on behalf of the French Elmore Company, and M. Secretan on behalf of a French company.

Mr. DUNCAN, the receiver, explained the various clauses of the agreement.

On the suggestion of the Chairman, the meeting resolved itself into an ordinary general meeting.

The CHAIRMAN said the first proposal on the agenda paper was to consider the agreement for the sale of the works at Dives. He would propose the resolution, "That this meeting approves the sale of the works, effects, and patents, to M. Secretan."

This was seconded and carried *nem. con.*

The report and accounts were then adopted.

The following resolution was also adopted: "That it is proved to the satisfaction of this company that it cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and that the company be wound up voluntarily."

The meeting then closed.

Woodhouse and Rawson United, Limited.

THE following circular was issued by the receiver, Mr. F. D. Leslie, to the holders of first mortgage debentures and debenture stock, on Monday last:—

"In March last I was appointed by the Chancery Division of the High Court of Justice receiver and manager of this company, on behalf of all the debenture and debenture stockholders, and since that time I have been endeavouring to arrive at the position and prospects of the undertaking, and to satisfy myself as to what would be the most advantageous course to pursue in the interests of the debenture-holders and other secured creditors. I may say that I found the accounts in such a state that it was extremely difficult to arrive at either the amount due to the company or its liabilities. I am now, I trust, succeeding in bringing the accounts into a satisfactory shape. There are so many branches and agencies spread all over the world that it is almost an impossible task in something less than two months to get at the true position of the whole undertaking. I have, however, with the sanction of the Court, despatched an agent to Africa, who will investigate the position there and look after the assets to the extent of over £20,000, which the books of the company show are at Johannesburg and the other South African agencies. I have taken steps to preserve the assets in Sydney, and to settle the difficulties with the Barcelona and Milan agencies. I have closed down the Bristol branch and Hamburg agency, and am gradually doing likewise with the Cadby Hall works. I have reduced the expenses at head office on account of salaries, wages, and rent at the rate of over £4,000 per annum. I have obtained leave to collect the debts due to the company on behalf of and for the benefit of all the debenture and debenture stockholders, and to deal with the outstanding calls in the same way, except so far as they are specifically pledged as security for previous advances, and I have generally, so far as I have been able, done all that I can to keep the business alive and preserve the estate for the benefit of those who are entitled to it. It is very difficult to estimate what the various classes of debenture holders may reasonably expect from a realisation of the estate, because so much depends upon the way in which it is realised. Speaking with considerable doubt, I am inclined to think that the first mortgage debenture holders and the secured debenture stockholders (issued in December, 1892), may expect to be paid in full, but as to the debenture stockholders (5½ per cent.), I have very little doubt that unless some reconstruction scheme is proposed and carried through they will be considerable sufferers by the unfortunate stoppage of the company. As to the feasibility of reconstruction and the proposals which are, I am told, about to be made, it is quite impossible for me to speak until some scheme in a concrete form is offered for the approval of the various classes of creditors. As soon as this is done (if at all) I shall consider it my duty to study the same, and to advise to the best of my ability the debenture stockholders whose collective interests I now represent. I shall at all times be anxious and ready to give every debenture and debenture stockholder all the information in my power.

"F. D. LESLIE, *Receiver and Manager.*"

The West India and Panama Telegraph Company, Limited.

THE report of the directors for the half-year ended December 31st, 1892, to be submitted to the thirty-second ordinary general meeting, May 16th, 1893, reads as follows:—

"The directors submit the accounts for the six months ended December 31st, 1892. The amount to credit of revenue is £38,358 11s. 9d., against £36,141 2s. 8d. for the corresponding half-year of 1891, and the expenses have been £25,155 11s. 5d., against £25,296 3s. 11d. for the same period in 1891, leaving a balance of £13,203 0s. 4d., which, with £3,704 15s. 2d. brought from last account, makes a total of £16,907 15s. 6d. Of this sum the directors have placed £1,500 to reserve, leaving an available balance of £15,407 15s. 6d., with which it is proposed to deal as follows:—

	£	s.	d.
First Preference Shares—			
Dividend, 6 months to December 31st, 6s. per share	10,368	18	0
Second Preference Shares—			
Dividend, 6 months to December 31st, 6s. per share	1,400	14	0
Ordinary Shares—			
6d. per share (free of income tax)... ...	2,208	0	6
Balance to current half-year's account ...	1,430	3	0
	£15,407	15	6

The traffic receipts for the six months show an increase of £2,065 7s. 1d., as compared with the corresponding period, which is solely due to greater activity in West India trade. The cost of repairs to cables amounted this half-year to £12,013 7s. 3d., as compared with £15,055 18s. 2d. for the corresponding period. The company's ss. *Grappler*, after having been repaired and fitted with a new boiler in London, arrived in the West Indies with a cargo of 256 nautical miles of cable for stock on the 23rd ult. Since the close of the half-year, the directors have to report that the colony of Trinidad, whose 10 years' term of subsidy of £6,000 per annum expired on December 31st last, has reduced its grant to £3,000 for 1893, and that St. Lucia has also reduced its subsidy from £800 to £500 for the current year. The directors feel that these curtailments of subsidies, following as they do so shortly after the company has made the sacrifice of largely reducing rates, cannot be looked upon but as a heavy blow to the anticipations of some improvement in the return on the capital invested in the enterprise which, for the last 20 years, has done so much for the commerce, the safety, and the administrative economies of the West India colonies, and so little for the shareholders. In accordance with the articles of association, Sir James Anderson and William Andrews, Esq., retire at this meeting, and offer themselves for re-election. John George Griffiths, Esq., the auditor, also retires, and offers himself for re-election. Shareholders being empowered by the articles of association to vote and be represented by proxy at the general meetings of the company, a form of proxy is enclosed, which, to be of use, should be returned to the company's office at least 48 hours before the time of meeting."

The following circular, dated May 8th, 1893, has been issued along with the report:—"The directors regret to announce the death of their esteemed colleague, Sir James Anderson, which has occurred since the accompanying report was in print. For the reasons stated in the directors' report presented to the last ordinary general meeting, it is not proposed to fill up the vacancy in the board thus occasioned. As, however, the articles of association fix the minimum of directors at six, and there now remain but five directors on the board, it is necessary to obtain the sanction of the shareholders in general meeting to an alteration of this minimum. It is therefore intended, at the extraordinary general meeting, of which notice is endorsed hereon, to propose to the shareholders that the minimum number of directors shall, until otherwise determined, be four instead of six."

Companies Struck off the Register.—The *London Gazette* for May 9th contains the following announcements:—

The names of the undermentioned companies have been struck off the register, and such companies are hereby dissolved:—

Durand Electric Petroleum and Gas Engine and Manufacturing Company.
Johannesburg Electricity Supply Company.
Morgan's Automatic Electric Signal System Syndicate.
Universal Electric Light and Power Trust Corporation.

Also at the expiration of three months from May 9th the names of the following will, unless cause is shown to the contrary, be struck off the register and the companies dissolved:—

Amalgamated Electricity Supply Companies.
Barry and Cardiff Electric Light and Power Supply.
Bristol Electricity Supply Company.
Canterbury Electricity Supply Company.
Cardiff Electricity Supply Company.
Column Printing Telegraph Company.
Combination Telephone and Electrical Engineering Company.
Dalmatia Mining and Electric Power Company.
Edison Phonographic Toy and Automaton Company.
Electricity Supply Companies' Union.
Electro-Chemical Syndicate.
Electrolytic Syndicate.
Hanley (Staffs.) Electricity Supply Company.
Kidderminster Electric Light and Power Supply, Limited.
Loughborough Electricity Supply Company, Limited.
Manchester Electricity Supply Company, Limited.
Northern Counties Electric Light and Power Supply, Limited.
Penzance Electricity Supply Company, Limited.
Sherrin Electric Power Generator Company.
United Electricity Supply Companies.
Weston-Super-Mare Electricity Supply Company.
Weymouth Electricity Supply Company.

The Telephone Company of Austria, Limited.—The *London Gazette* contains a notice to the effect that at an extraordinary general meeting of the above company, held at 53, New Broad Street, E.C., on February 1st, 1893, the following special resolutions were duly passed; and at a subsequent extraordinary general meeting of the members of the said company, on February 16th, the said resolutions were duly confirmed, viz.:—1. "That the company be wound up voluntarily under the provisions of the Companies Acts, 1862 to 1890." 2. "That Henry Grewing, Esq., C. L. W. Fitzgerald, Esq., Robert E. Bateman, Esq., and J. H. Buckingham, Esq., be and they are hereby appointed liquidators for the purpose of such winding up, and that every power vested in such liquidators may be exercised by any two of them."

Consolidated Telephone Construction and Maintenance.—At a special board meeting last Tuesday, it was resolved, subject to audit, that dividends at the rate of 6 per cent. per annum on the preference, and 2 per cent. per annum on the ordinary shares, both less income tax, should be declared for the year ended March 31st at the approaching annual general meeting of the shareholders. The transfer books will be closed from the 19th to the 27th inst., both inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending May 7th, 1893, amounted to £793; week ending May 8th, 1892, £802; decrease £9; total receipts for half-year, 1893, £16,153; corresponding period, 1892, £14,898; increase £1,255.

The Great Northern Telegraph Company. The traffic receipts in April, 1893, amounted to £20,800; January 1st to April 30th, 1893, £84,000; corresponding months, 1892, £82,800; corresponding months, 1891, £88,000.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 5th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £3,847.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation, May 4th.	Closing Quotation May 11th.	Business done during week ended May 11th, 1893.	
					Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 — 104	101 —104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	53 — 54	51½— 52½	52½	51⅝
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	94 — 95	93 — 94	94½	93
2,876,140*l*	Do. do. Deferred	Stock	13 — 13¼	12½— 13	12⅝	12½
130,000	Brazilian Submarine Telegraph, Limited	10	11¾— 12¼	11⅝— 12¼	12⅛	11 3/16
36,400*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	106 —110	107 —111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3½— 3⅝	3½— 3⅝	3⅝	3 5/16
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2¼— 2½	2¼— 2½	2⅝	...
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	109 —111	108 —110	110½	109½
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12¼— 12⅜	12¼— 12⅜	12⅝	12½
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10½— 11	10½— 11	11	10⅝
$7,716,000	Commercial Cable, Capital Stock	$100	140 — 150	140 —150	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	3/16— 5/16	3/16— 5/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½— 5⅝	5½— 5⅝	...	...
16,000	Cuba Telegraph, Limited	10	11½— 12½	11½— 12½	11⅝	...
6,000	Do. do. 10 p. c. Preference	10	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝ — 12	11⅝ — 12	12	11⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15⅜ — 15⅝	15½ — 15⅝	15 13/16	15⅜
70,000	Do. 6 p. c. Preference	10	16½ — 17	16½ — 17	...	...
1 5,900*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	108 —111	109	...
1,294 100*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116 xd	113 —116	115	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅝ — 15¾	15⅝— 16	16	15⅝
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	1 4 —107	104 —107	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	104 —107	104 —107	104½	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	114 —117	114 —117	114	...
1[illegible]8,700*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	103 —106	103 —106	...	...
146,800*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 —106	103 —106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	102⅞	102
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	2½— 3	2½— 3	2⅝	2⅝
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16— 3/16	1/16— 3/16	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/8— 3/8	1/8— 3/8	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd,	2	0— ¼	0— ¼	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	1 — 2	..	...
180,227	Globe Telegraph and Trust, Limited	10	9⅞— 10⅛	9⅞— 10⅛	10	9 13/16
180,042	Do. do. 6 p. c. Preference	10	15⅝— 15⅞	15¾— 16	15 15/16	15¼
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19¼xd	19 — 19½	...	...
200,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	106	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½— 5½	4½— 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½— 7½	6½— 7½	...	..
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	23 — 24	23 — 24	23⅞	23 1/16
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	102⅝	...
17,000	Indo-European Telegraph, Limited	25	43 — 46	43 — 46	44½	44
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½— 3½	2½— 3½	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4¼ — 4½	4¼— 4½	4¼	4 1/16
10,000	Do. do. fully paid	5	6 — 6½	6 — 6¼	6½	5⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6¼— 6⅝xd	6¼— 6⅝xd	6 1/16	6⅜
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅛
15,000	Do. 6 p. c. Cum., 1st Preference	10	15 — 15½	15 — 15½	15 5/16	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	14¾— 15¼	14½— 15	14⅝	...
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛— 5⅜	5⅛— 5⅜	5 11/16	5 7/16
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	115½	113½
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,451	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	...	...
11,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅞— 8¼	7⅞— 8¼	...	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	...	...
3,581	Submarine Cables Trust	Cert.	120 —125	121 —126	...	...
78,949	Swan United Electric Light, Limited ... ... (£3¼ only paid)	5	3 — 3½	3 — 3½	3½	3⅛
37,350	Telegraph Construction and Maintenance, Limited	12	29 — 31	30 — 32	31½	29½
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	2 — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½— 6½	5½— 6½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	102	100⅜
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	2⅜	...
130,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	99 —103	102 —106	102½	101½
64,242	Western and Brazilian Telegraph, Limited	15	7⅞— 8⅛	7⅞— 8⅛	8	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½	...	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1⅞ — 2¼	1⅞ — 2¼	2	1⅞
178,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	106 —109	107 —110	...	...
222,700*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	106 —109	106 —109	...	..
88,321	West India and Panama Telegraph, Limited	10	1½— 1⅝	1⅜— 1⅝	1⅝	1 9/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½— 12	11½— 12	11¾	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9½ — 10½	9½ — 10½	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	108 —111	108 —111	110	109¾
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125 xd	120 —125	...	...
160,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	...	...
99,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½— 6	5½— 6	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5½—6.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100–103.—Electric and General Investment, shares of £5 (£1 paid), 1½—2½.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5⅜.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅝—5⅞ xd, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6½ xd.—Liverpool Electric Supply Shares of £5 (fully paid), 6—6¼.—Manchester, Edison and Swan Company, 49 (£1 paid), ⅛—⅜.—Queen Anne's Mansions Lighting and Heating, 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3 per cent. (May 4th, 1893).

SOME NOTES ON THE DESIGN OF SERIES MOTORS FOR TRACTION.

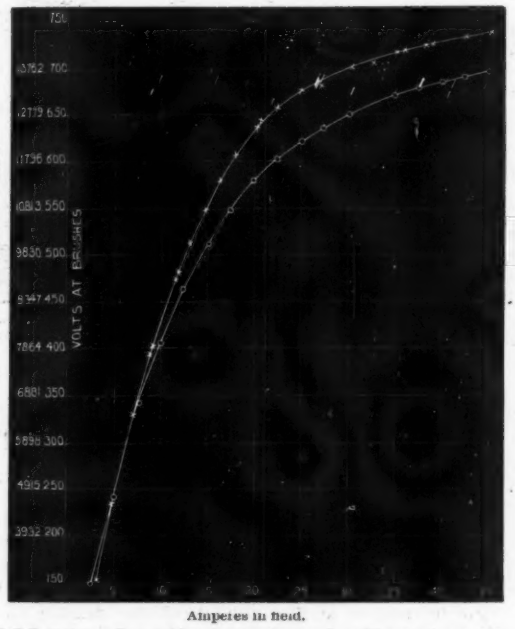
BY J. DOUGLAS DALLAS.

IN dealing with some points in the construction of series motors, it will generally be intended as referring to street tramway practice in the United States. The following conditions are essential to the construction of a successful motor :—

1. Lightness.
2. Low armature speed.
3. Waterproof and mudproof as far as possible.
4. High torque, for starting under heavy loads on gradients and curves.
5. Few parts and all easily accessible.

The most important condition of these is the third, water and mud during the winter months being the most fruitful source of trouble to the engineers. Having stated some of the essentials of a commercially successful and satisfactory motor, it may be well to take each part and deal separately with it, at the same time indicating the general trend towards which designers seem to be aiming at the present time, and the improvements which may be looked forward to in the near future.

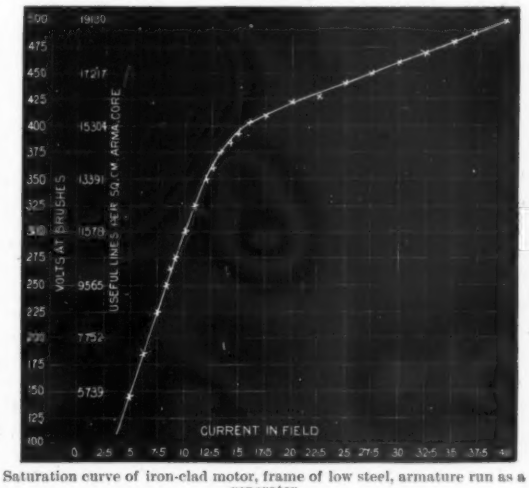
The frame of the machine.—Bipolar motors may be classified as belonging roughly to either the horse-shoe or consequent-pole type of magnet. The now obsolete double reduction motors belonged to the former class, and we may instance the Sprague-Edison, the Bentley-Knight, &c. To this class also belongs the "F" type of double reduction motors, which were the pioneers of successful electric traction in America, and won for the Thomson-Houston Company a great reputation on the West End Street Railway, of Boston. The Westinghouse Electric Company also brought out a double reduction motor of this type, which has now been superseded. To the consequent-pole class of machine belong the two single reduction types of motor of the



S.R.G. R.R. motors.—Comparison of saturation curves, with pole pieces of Cape Ann forged iron and mitis metal; Cape Ann denoted ×; mitis metal denoted o.

FIG A.

Thomson-Houston, as well as the Rae, Edison, and other motors. In the former class of machines the armatures were of the drum type, and in the second class, nearly without exception, of the ring type. Frames should be, preferably, castings either of mitis metal or low Bessemer steel, and never of cast-iron, if possible. Mitis metal is cheaper than wrought-iron, and requires very much less machining, mitis metal having a permeability of 90 per cent. of that of the best wrought-iron. Cast-steel is perhaps superior to mitis metal in some respects, as sounder castings can be more easily obtained. Fig. A gives a comparison of mitis iron and wrought-iron; the results may be taken as being correct within less than 1 per cent., and the curves fairly represent a comparison between the two metals in practice. Some grades of low Bessemer steel have a higher permeability than wrought-iron. In fig. A the method of test in each case was the same, the fields being separately excited, and the armature run as a generator. The cross-section of iron was in each case the same, and run with the same armature. The type of motor was single reduction gear, with two field coils coupled in parallel. The armature was of the ring type, with an iron-headed core. The least area of iron in the frame was 33 square inches on each limb, and the area of iron in the core was 51·75 square inches. The speed of the armature was a constant. The next figure, C, represents



Saturation curve of iron-clad motor, frame of low steel, armature run as a generator.

FIG. C.

the saturation curve of an iron-clad single reduction gear motor. With the exception that the wire on the armature was wound in slots on the periphery, it was in other respects similar to the machine in curves A. A reference to the two curves will quickly make apparent the effect of the air gap in C. The total air gap in A equals 1 inch, and in C

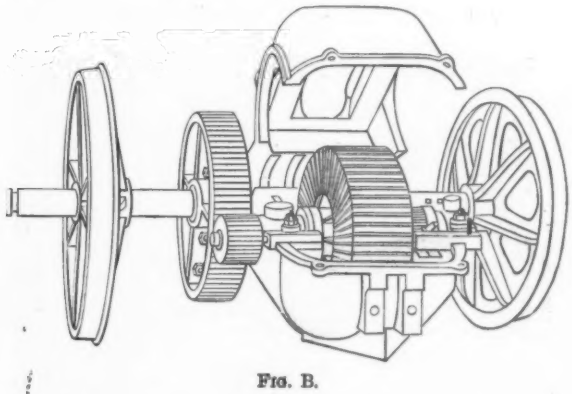


FIG. B.

¼-inch. The general bent in motor design just now is towards multipolar machines of the iron-clad type, with a view to box up the armature as far as possible against mud and water, and also to reduce the dead-weight and speed of the armature. Many of the motors are now constructed with hinges on the axle, to allow of speedy removal of the armature, which can be effected by merely tilting the top of the motor back. Figs. D and B, taken from an advertisement, give perspective views of an iron-clad S.R.G. motor. It will be readily seen that the motor is waterproof as far as the centre of the armature shaft. The dimensions of this motor are such that it may be operated on a narrow gauge railway as small as 3 feet. The gearing of the motor will be treated later on. The disadvantage of the motor, mentioned in fig. A,

lay in the fact that it could only be used on gauges of 4 feet 8½ inches, and larger, or when placed on a 4-foot gauge, the web of the wheels had to be reversed. However, it was most efficient, and, as the pioneer of single reduction railway motors, performed excellent work. This type of motor is in use on the short line operated in Leeds, and witnessed the adoption of the ring type of armature, a type

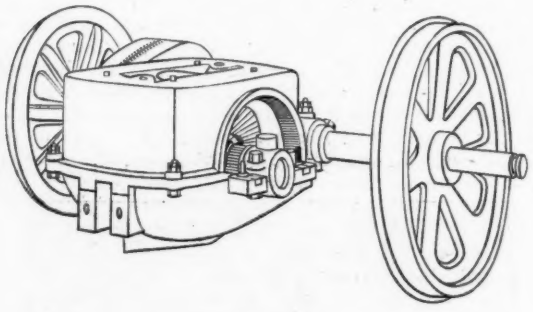
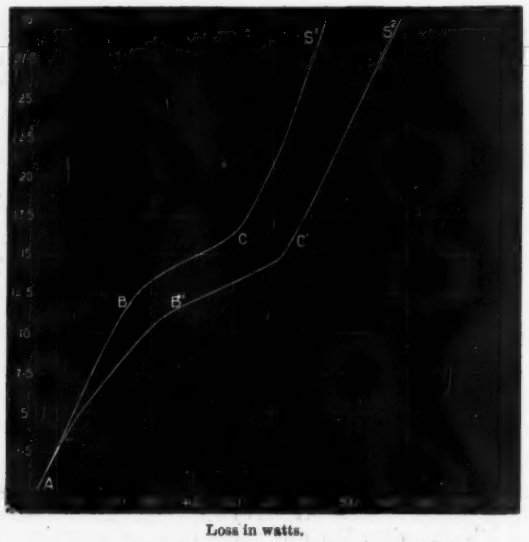


Fig. D.

which the writer thinks will never be departed from. Next, as to the cores of armatures. In the latest form, brass spiders have replaced the older forms of iron ones. The spiders are keyed on to the shaft and secured in place by a nut, which allows of a newly-wound core to be slipped on an old shaft, should the winding be injured or become faulty. The cores are wound in one continuous length, the two ends being welded together. The connections to the commutator are small cables, welded or soldered to the continuous winding. If two armatures be taken, similar in winding and cross-section of metal, one being iron-headed, the other gun-metal, and if these two armatures be tested in the same frame, it will be found that when the brass-headed armature is in the machine the core losses will be smaller, the speed rather higher, but the torque nearly the same as before. The efficiency will be, consequently, higher. This is accounted for by the waste lines being fewer. The higher efficiency itself would not constitute a reason for making so radical a change in the design of motors, were it not that the limiting temperature of the armatures has been also very much reduced. The heating due to $C^2 R$ losses in an armature is very small; an examination of curves of core losses in a fully saturated field may be interesting and instructive. A railway motor field is always fully saturated. In the accompanying diagram the knee of the curve is reached with



Loss in watts.

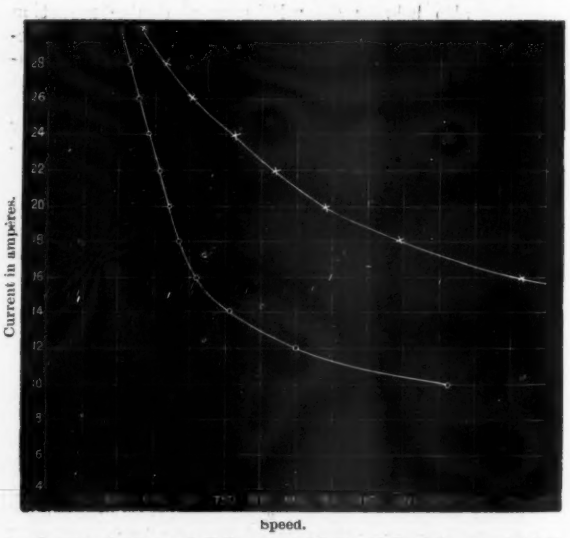
Curves of core loss at two different speeds with high magnetic induction.

Fig. K.

12^a. From A to this point, which we may designate B, the loss varies directly as the increase of strength of the field; from B to C it takes a quick bend, the loss increasing very rapidly from the point nearly saturated to that fully saturated. From C increased magnetising power only increases the induction very slightly; so, as might have been expected, the increased core loss is almost imperceptible. The two curves are taken at random, and represent the core losses at two different speeds of the same armature. All core loss curves are of the same shape when taken in a fully saturated field. A certain motor-core loss has been reduced from an average of 1,400 watts to about 800 watts by improvements in the quality of iron, and by its construction. A good saturation to use is 100,000 lines per square inch with mitis or steel. When the motor is fully loaded, a 15-H.P. motor, at 500 v., should take about 30 ampères. An S.R.G. motor on a truck, with 30-inch wheels with 12^a, has a speed such that the car is running at 11 or 12 miles an hour. It has been the aim to get the field fully saturated at this point, that is, to have reached the knee of the curves, so as to get the full benefit of the torque. The measure of the torque is

$$\text{Total kapp lines} \times \text{convolutions on the armature} \times 7{\cdot}0415 \times 10^{-9} \text{ in foot lbs.}$$

Another reason for saturating the field is that, supposing the current were to drop from 12^a to 10^a (supposing that we were operating with the motor mentioned above), if the field were not saturated, the consequence would be a severe and sudden fall in the number of lines, the motor would be unduly accelerated, and bad sparking would also be caused, on account of the shifting of the neutral point. Instead of two ampères difference in the load making 40 revolutions difference in speed, a difference of about 150 or 160 might be produced. Curves M and N are examples respectively of a



Speed.

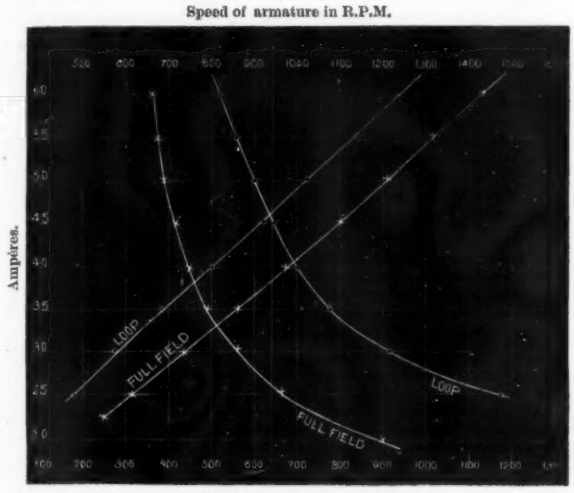
Speed curves of motors:—I. Fully saturated field; II. Partially saturated field.

Figs. M and N.

good and bad speed curve. A good speed curve should take the form of M, if the motor is to regulate well. With a constant potential, a motor with the same load will always run at the same speed on a level; other conditions of track, &c., being the same.

The Thomson-Houston Company, in order to accelerate their cars, put their motor on what is known as the "loop." Putting a motor on the loop refers to the alteration of the number of turns of wire on the field magnets. Say, for example, that a motor be running at 600 revolutions per minute on the level with the full field, the same motor on the same track would, on the loop, be running at 750 revolutions per minute. The torque will, of course, be reduced (see fig. A A); the induction of $C^2 R$ losses will also be reduced in the machine, so that at some loads the motors will be working at a considerably higher efficiency than if operated on the full field. However, on gradients, or with very heavy loads, the operation of motors on the loop is not economical. Fig. S, one efficiency curve on end, the other same motors on the loop. The following are the data on the windings of an obsolete form of motor, armature ring type:—Number of coils, 64; number of turns per coil = 16; size of wire, No. 13 A.W.G.; field coils, two in parallel, each one wound

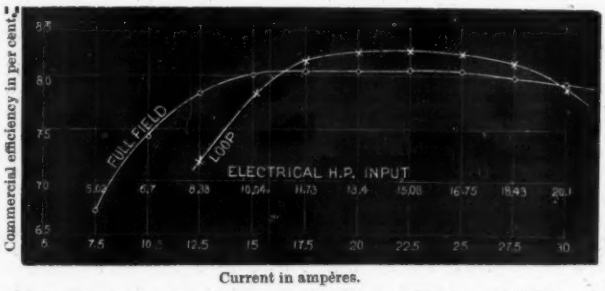
with 206 turns of No. 10 and 463 turns of No. 11; consequently this motor, on full field, had two sets of 669 turns in parallel, and on the loop two sets of 206, also in parallel. The mean length of one turn on either field coil was 5·19 feet; area of iron in both limbs, together = 66 square inches at the smallest cross-section. Area of iron in the armature, 51·75 square inches, air gap (total) = 1 inch.



Axle torque in foot pounds.

R. R. motor curves of speed and torque taken on water brake frame of cast steel.

FIG. A A.



S.R.G., R.R. motors.—Curves of commercial efficiency, with gears on full field and loop reduction = 4·78.

FIG. S.

For cars, perhaps, the best known form of suspension is that due to Sprague, and adopted by the Edison General Electric Company. In the case of the old form of motor with double reduction gearing, the suspension consisted essentially of a brass or gun metal nose plate with guide and double set of springs, which form is too well known to need description here. The yoke, or keeper, was suspended on the axle of the car, the bearings being phosphor bronze or brass, with caps to keep the motor in position. In the Sprague-Edison motors of double-reduction gearing, the axle gear and the intermediate pinion, were on the same side as the commutator, with the axle pinion and intermediate gear on the other end of the motor. In the Thomson-Houston form of suspension, four rubber cushions are used in the place of the springs with a guide rod. Some motors have also been suspended by a bolt tapped into the top of one pole piece with rubber springs. With two standard motors a truck must have a wheel base of not less than 5 feet 9 inches, and preferentially of 6 feet.

(To be continued.)

ELECTRICITY AND NATIONAL ECONOMY.

BY E. TREMLETT CARTER.

IT is a popular but by no means self-evident belief, that electricity is going to revolutionise the world. The coming age of electricity, we are often told, is to witness a complete devastation of our present social and industrial economy—to usher in the millenium of perfect bliss and unsurpassable physical comfort. The demolition of existing modes of utilising the great forces of nature for the convenience of man, by the improved electrical appliances which are yet—all too invisible, alas!—in the womb of the future, will not fail to be accompanied by the exit of nearly all that goes to make up the total of human sorrow and discomfort—the overcrowding and competition of dense aggregations of humanity, the filth and unhealthiness arising from the use of coal, the poverty arising from the unequal balancing of effort and result. Such is the picture we have often had painted before our eyes; and such is the gospel of technical progress which is preached in some recent numbers of our contemporary *Electricity*. As in the last few decades the cry had been, "All through steam!" so, says our contemporary, in the coming millenium the cry shall go forth,—"All through electricity!" Reacting upon the conditions of industrial production, electricity is to work a revolution which to many modern industries will be "little short of a catastrophe." "Springing from the same sublime source" (as heat), electricity "will elevate coming generations to a higher stage of culture, to a purer mode of living." Its applications on every hand, through the coming strides in natural science, "will render us more and more independent of nature, and instead of the miserable pittance we now obtain in the sweat of our brow, we shall gain abundant gifts according to our will and pleasure." The writer of the articles seems to have ascended to the seventh heaven of hope and expectancy. He would, as it were, take us to the summit of Olympus, from which deific height we may survey all the kingdoms of the future of the world and the glory thereof. From such a lofty pinnacle, it may be an unpleasant fall to plain, level earth and to the facts and figures of political economy; but we must make it. To wander on the mountain-tops of imagination is as easy as it is fruitless of practical value. Aladdin's lamp, even with an electrical syndicate at the back of it, cannot seriously be transferred from fiction to scientific and commercial literature. Therefore, we should enquire in how far the rosy pictures of electrical progress are consistent with established principles of social and industrial economy.

The undeniable and deep-rooted revolution which was wrought by the introduction of steam, and by the developments in the iron and steel industry, may at first sight appear to furnish a precedent upon which we may logically base the inference that a similar revolution will be effected by electricity. A little examination discloses the fallacy. The social and industrial tendencies of steam were diametrically opposed to the conditions which existed at the time of its introduction; those of electricity run nearly, if not entirely, parallel. The substitution of the former involved a radical change in the order of things; the substitution of the latter emphasises and strengthens the existing order. Steam came into a slow-coach world of villages, driven by horses. It found the conditions of industrial production dwarfed and hampered by the isolation and smallness of communities; and it collected the multitudes of small communities into a few vast communities, and broke down the barriers to cheap and rapid transit of materials in the raw and manufactured forms. By these effects, steam came as a direct aid to the building up of an industrial system. Cheap power and labour, direct combination of capital, rapid transit of goods during the stages of manufacture, intimate contact between the factory and the market, these are a few of the essential conditions of a paying industry. These all were aided by the introduction of steam, which fostered the city in place of the village, the large factory in place of the small producer. Electricity comes, upon the top of this revolution, as a further impetus in the direction of its already well-marked tendencies. Not as a destroyer of the aggregation of capital in the factory, or of the aggregation of human beings in cities, but as an agency for the maintenance and considerable increase of these factors in social life, will electricity operate. Shall the fact that electric energy can be transmitted several miles with as little loss as mechanical energy may be transmitted over a distance expressed in no greater number of feet, militate against the city life and the factory life; when, to scatter an industry over a large rural district instead of focussing it in a city, would diametrically oppose all commercial requirements? Cheapness of power could not outweigh the inducements to having all the stages of manufacture compactly under one roof, and the whole establishment close to the market. It may be taken as having the highest probability, that the

introduction of electricity would have no tendency to destroy our present city life and our factory systems. That being so, and the tendency really being in support of that life and of those systems, electricity can not be regarded as in any way fostering a counter-revolution, but as further propping up the former one. Cables may take the place of belt gearing, motors may take the places of horses in carriages, electric trains may go at high speeds over railways originally run by steam, the dirt and inconvenience of coal and gas may be abolished. But the city will remain, the city life will be little modified; factories will stand as of yore, though without the chimneys, and will be crowded together where market conditions rule the lowest cost of production and the highest selling prices; the social and industrial world, though impelled by a new physical force, will be impelled along its former path towards an unchanged goal.

NEW PATENTS—1893.

8,197. "Improvements in electric distribution and apparatus connected therewith." W. ALDRED. Dated April 24th.

8,315. "Improvements in switches for electric currents." A. G. NEW and A. J. MAYNE. Dated April 25th.

8,316. "Improvements in the electrical propulsion of boats and vessels." A. G. NEW and A. J. MAYNE. Dated April 25th.

8,330. "Improvements in and relating to electric car brakes." M. E. COMPANY. Dated April 25th. (*Complete.*)

8,331. "Improvements in electrical lock and block apparatus for railway points and signals." E. TYER. Dated April 25th.

8,391. "Improvements in or connected with electric bells." C. TURNBULL, Jun. Dated April 26th.

8,427. "Improvements in apparatus for regulating electric currents." L. B. MILLER and M. W. WOODS. Dated April 26th.

8,436. "Improvements in controlling or regulating the supply of electricity, and apparatus therefor." G. MARTIN. Dated April 26th.

8,453. "The improved railway block, telegraph lock, and indicator." H. YEARSLEY. Dated April 27th.

8,502. "Improvements in electrical railways and tramways." W. L. WISE. (Communicated by A. Diatto, Italy). Dated April 27th. (*Complete.*)

8,567. "Improvements in portable electric lamps." O. MARCH. Dated April 28th.

8,571 "Improvements in or connected with cells for electric batteries." H. C. W. EMERY. Dated April 28th.

8,600. "Improvements in continuous current dynamo-electric and electro-dynamic machines." A. I. GRAVIER. Dated April 28th.

8,618. "Improvements in multiple change-over mechanism for electric arc lamps." W. J. DAVY. Dated April 29th.

8,649. "Improvements in telegraph insulators." J. MORRIS. Dated April 29th.

8,654. "Improvements in electric arc lamps." W. J. DAVY. Dated April 29th.

8,675. "Improvements in or relating to galvanic batteries." R. J. CROWLEY and J. R. GRANT. Dated April 29th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

13,714. "Improvements in and relating to apparatus for measuring electric currents." H. W. MILLER. Dated August 14th. The inventor provides an electrolytic bath of suitable composition having a metallic anode and cathode, which may be either zinc, copper, or silver, or other suitable metal, and at a suitable distance between them he places a metallic conductor preferably in the form of a balanced cylindrical wheel, arranged to revolve freely in the liquid upon a horizontal axis; the anode and cathode are so shaped as to embrace opposite portions on either side of the cylindrical conductor, leaving a suitable amount of clearance. The operation of the apparatus is as follows:—On passing a current through the bath from the anode to the cathode, metal is dissolved from the anode and is deposited on that surface of the cylindrical conductor which it embraces, the metal thus deposited upsets the equilibrium of the cylinder and causes it to turn towards the anode; at the same time metal is dissolved off the opposite face of the cylinder and is deposited on the cathode, the cylinder thus becomes heavier on one side and lighter on the other and consequently revolves, and in so doing presents fresh surfaces to the anode and cathode, the action being thus continued the cylinder continues to revolve as long as current passes through the bath. The said cylinder or wheel is connected by means of toothed gearing or in any other suitable manner with a dial or dials for registering or recording the number of revolutions of the same, and from this is deducted the quantity or amount of electric current that has passed through the apparatus. 2 claims.

14,089. "Improvements in electrical measuring apparatus." A. RECKENZAUN. Dated August 20th. Relates to certain improvements in that class of electrical measuring apparatus in which the desired record or indication is obtained by influencing the rate of the oscillations of a suspended magnet, by means of a coil or coils placed in proximity thereto, through which the electric current to be measured passes. The object of the invention is to obtain a record or indication of measurement by dispensing with ordinary clockwork, pendulums or balance wheel, substituting therefor simpler and more reliable mechanism. 6 claims.

17,148. "Improvements in electric switches." W. B. SAYERS. Dated October 8th. Claim: In an electric switch making the contact making and breaking device in the form of a flexible metal ring loosely mounted upon an insulated holder, the holder being connected directly or through intermediate mechanism with an operating device or handle by means of which the said loose flexible ring is forced in between or against the contacts or points between which it is desired to make or break electrical connection, substantially as described and illustrated and for the purpose specified.

17,581. "Improvements in electric insulators." F. J. MORGAN and W. R. JAMES. Dated October 15th. Relates to an insulator which consists of non-conducting material having two grooves cut at different angles and so arranged that the pull of the wire in any direction, except longitudinal, will be held in position by the grooves without the assistance of any binding wire. 1 claim.

17,719. "An improved electric or galvanic battery and its adaptation to brushes and other articles." A. H. BYNG. Dated October 16th. The improved battery is made in two parts or halves which can be made as required, either to meet or to move apart from each other. Each part or half is provided with plates of zinc and copper or other combination of elements so arranged that when the halves are brought together or made to meet, the battery is formed, while, on the other hand, when the halves are separated the battery is put out of action and decomposition of the positive plate prevented. 4 claims.

17,818. "Improvements in or connected with electric transformers or induction apparatus." L. PYKE and E. S. HARRIS. Dated October 17th. Relates to high tension transformers with liquid insulation, and more especially to the transformers described in the specification of Pyke and Barnett's Patent No. 3,900, of 1890, where special means are provided to promote the circulation and cooling of the liquid used for insulation. The objects of the improvements are, to avoid a separate cooling vessel, and generally to simplify the construction and render the apparatus more convenient for use. 2 claims.

18,285. "Improvements in electric switches." A. BURTON. Dated October 24th. Has for its object the production of an electric switch with a porcelain or equivalent insulator in combination with safe and absolute metallic contacts. 1 claim.

18,423. "An improved telephone combination." Sir C. S. FORBES. Dated October 27th. Consists in employing the same magnets which generate the current for ringing, to produce a polarised condition of the core and tympan or plate placed near to, or between the pole-pieces forming part of the magnets, or fixed thereto. 6 claims.

19,314. Improvements in and relating to incandescent electric lamps." H. H. LAKE. (Communicated from abroad by La Société dite Electriciteits Maatschappij, System de Khotinsky, Germany.) Dated November 7th. Comprises a plate of any suitable material arranged between the connecting points or junctions of the platinum wire and the carbon filament. This plate, preferably made of glass, has the form of a circular disc and is fixed to a small stalk secured to the bulb of the lamp in such a manner that the junction of the platinum wires with the filament are at the same level as the centre of the plate or disc. The object being to prevent "flaming." 1 claim.

CORRESPONDENCE.

Modern Gas and Oil Engines.

You have indulged in some strong criticism in your article in this week's issue on "Modern Gas and Oil Engines." I have had the opportunity of reading the article in *Cassier's Magazine* you refer to, and sure enough your criticism is quite correct, taking that article as a basis. But it would be entirely wrong to take it as an indication of what gas engines can do; it does not show any engine of first class make or of the latest designs, and I think it unfair to criticise the gas engine for shortcomings which have really no existence. To use your own words applied to the electrical motor on page 450, "Engineers rather remind us of the child crying for the moon; they cannot obtain their ideal motor, and therefore reject the motors at hand, &c." Gas engine makers have nothing to thank electrical engineers for; the latter prefer to put down often enough a fifth rate steam engine to a gas engine of modern design. As a last resource they are put down sometimes when everything else fails. Your illustration of the number of impulses

per minute in a gas as compared with a steam engine shows that the editorial mind is not up to date; the four-cycle gas engine indeed receives but one-fourth the number of impulses that a steam engine does, but there are others receiving one-half the number of impulses. Good ones, too, though I won't mention names. Even the four-cycle engine can do good electrical work, and hundreds of installations can be seen all over the country where they are successful. Your complaint that improvements are required in the gas engine (they are also required in steam) is too true, but fashion is against them; the public has had its head seriously inflated with the importance of the four-cycle engine, especially as it means cheap engines. The universal copying going on of the "Otto" type of engine is a serious block to improvement, and a standing refutation to those who boast of the increase of our knowledge through technical education!

Hugh Campbell.

May 2nd, 1893.

Cutting Down Prices.

All electrical contractors should be grateful for your article in last week's issue of the REVIEW under the above heading, and I have no doubt many of the firms concerned in the particular competition under discussion will act on your suggestion, and criticise your approximate estimate. I venture to draw attention to the last paragraph of the article, however, as in my experience "the leading firms (or rather limited companies) of electric light contractors" are in many instances the great offenders, and not the smaller men, as you seem to fancy is the case, and for this reason: The smaller electrical contractor, as a rule, has not a large capital, and he is obliged to confine himself to work that will yield him a profit, or at least end without risk of loss. But the large limited concern, with its ambitious engineer, frequently embarks on contracts that, to a practical observer, can only end in a loss. The necessity to keep men employed is one reason sometimes given, and the desire to keep some other rival concern out another. One of these companies is just now engrossing a little attention in our law courts, and at the meeting of another recently, the shareholders were told that several contracts of great importance had been carried out which were engineering triumphs, and would no doubt in *the future* lead to remunerative business. In my opinion, it is this sort of competition that is doing the real harm, as shareholders' capital is being bestowed as a gift upon the customers of these companies, in the shape of work done at a loss, whilst the man who is anxious to do honest work at a remunerative rate finds himself supplanted on every hand. Some day, perhaps, shareholders in limited liability concerns such as I have referred to, will arrange to pay their engineers and managers by a percentage on the net profits earned. If they do this, I venture to hold that they will bestow a great boon on the trade at large, as well as upon themselves.

Howard G. Tozer.

Northampton, *May 2nd*.

Parks Modification of a Wheatstone Bridge.

In your description of the Parks modification of the Wheatstone bridge, it is stated that any one or other of the ratio coils can be used on either side of the balance, and as suggested by you, the reasons for such modification are not far to seek. With the existing bridge, however, the desired object is more conveniently attained by so joining up the other two sides of the Wheatstone "lozenge," that these can be interchanged at will. This involves alone the insertion of a simple reversing arrangement between the ratio coils and c and x, the adjustable and unknown resistances. After getting the balance in the usual way, the reverser lever is turned, and a "check" observation made with the two latter transposed, the corrected value of x being, of course, the *harmonic* mean of the two readings, as in the case of a telegraph line or cable traversed by an earth current.

With a reverser of the Thomson pattern, the circuit need not be appreciably broken or varied in resistance in effecting the transposition. Fortunately we, in this country, can mostly depend upon the practical accuracy of our bridges; but a ready means of discovering and correcting any slight want of balance between the ratio coils is clearly of service.

Returning to the Parks bridge, the advantages of the single set of ratio coils, in point of economy and portability, would not appear to atone for its inconvenience in the frequent case of measurements requiring a higher "even bridge" than 10 to 10.

H. W. Sullivan.

May 4th, 1893.

[The Parks bridge is practically the realisation of our correspondent's suggestion, with the additional advantages of compactness and economy which have been mentioned. The objection to the design, owing to absence of higher even bridge values than $\frac{10}{10}$, is one which we do not think would be found of material importance.—EDS. ELEC. REV.]

The Attractive Properties of a Current.

The experiment which Mr. W. J. Stubbs described in your last issue has been a cause of misgiving to many beginners. No doubt the references which are made to the attractive force of the magnetic whirl surrounding a conductor through which a current is passing are somewhat bald when read by the tyro, but it must be remembered that the text books cited do not profess to give instrumental instructions as to the carrying out of experiments which are briefly mentioned. The result of the experiment is often given at length, while the conditions limiting a successful demonstration are left to the knowledge of the lecturer, or to the handbooks which deal with laboratory work, such as Hospitalier, Stewart and Gee, Gray, and others. What the writers had in view was to impress upon the mind of the student that such things were capable of verification by actual trial, but it was not within their scope to deal with the practical conditions of experiment; rather theirs to lay down the theory upon which such experiments would rest. It may be of use to point out that many similar experiments require large currents to be used. In magnetic whirl apparatus friction or gravity invariably have to be overcome, and *power* must be provided by the source of electrical energy employed to do the necessary work entailed in so doing.

I have found that for this attraction experiment with a No. 16 B.W.G. bare copper wire, results fit to be exhibited require at least 10 to 12 amperes, while 16 to 20 show it remarkably well.

Charles H. Yeaman.

May 8th, 1893.

If Mr. Stubbs will refer to page 49 of my "First Book of Electricity *v.* Magnetism," he will find depicted in fig. 38 a parallel arrangement of cells which will give him the results required. If 12 ordinary single-fluid bichromate cells be arranged in three parallel rows of four cells in series, the E.M.F. and internal resistance of the battery will be respectively 8 volts and about, $\cdot 1\omega$, giving, therefore, nearly 80 amperes through a short wire, which current will cause a thick cluster of iron filings around the wire. The necessary current to get a good effect seems to be from 40 to 80 amperes.

W. Perren Maycock, M.I.E.E.

Relative Safety or Danger of Electric Light Current.

The letter of your correspondent, Henry E. Waite, M.D., is a peculiar one. He describes himself as a manufacturer of electro-medical instruments (and a remarkably conscientious one withal), and yet signs himself M.D. Such a combination is, to say the least of it, very unusual in this country, but perhaps he is an American M.D., and, as such privileged to do things which are denied to his medical brethren here. Electric light currents may be used with perfect safety, if reasonable precautions are taken.

Your correspondent's distressing list of possible dangers, though real enough as far as the outside wires are concerned, is quite beside the question when the supply of current inside a properly wired building is considered. Are there no such things as safety fuses and cut-outs? Are not lamps protected by their means everywhere? We quite admit that the ordinary commercial fuse or cut-out is not suffic

protection for medical purposes, and therefore have brought out an apparatus called the L. K. current controller, which renders the use of current from the main thoroughly safe to both patient and physician. It is based upon the principles laid down by Dr. W. S. Hedley in the *Lancet* some months ago, and gives the double protection of an *automatic and reliable cut-out* and a *shunt circuit for the patient*; having, of course, adjustable resistances suitably arranged.

By using the L. K. controller, whatever happens to the outside wires, it is impossible for more current to pass than the automatic cut-out is set to break circuit at; and, further, only such portion of this latter current can reach the patient in the shunt circuit as the respective resistances of the two circuits may be adjusted to allow.

Pro **The Electro-Medical Apparatus Company,**
Lawrence & Kirk, *Managers.*

Dr. Waite calls attention to a *possible* danger where medical apparatus is supplied by central station current, where overhead wires are used and one pole of generator is intentionally or accidentally grounded; but surely a most improbable coincidence of misfortunes to happen anywhere? In this country—of which Dr. Waite can hardly be thinking—such conditions are out of the question; but, leaving this, practice has shown that no such risk need be allowed for.

There is one other point to which I should like to draw that writer's attention. If a patient be treated in a consulting room or hospital theatre, two leads must be used to include him in the circuit, and without special intent such patient would not be "earthed." Without a fault to low tension mains from high, together with leak on other pole of high, no leak to earth on low tension and direct earthing of patient, no danger could exist.

With such systems of mains and supply as are employed at present, medical men and instrument makers can be assured that no such risk need deter them from, so far as is possible, making use of public supply of electricity, although if there be doubt, the officials of the supply company should be consulted. They, for their own sake, would give an honest opinion as to the advisability of so doing, having in view local circumstances.

In Statu Pupillari.

London, N.

A Strange Phenomenon.

Kindly permit me to draw your attention to a fact which may perhaps present some interest.

Having lately been engaged in applying a series of tests to underground cables in the G. mountains, I had, amongst others, to test the insulation of two electric light cables, coiled, each being about 10 metres long. As it was expressly desired that they should be examined at a low temperature, they were put in a newly finished hut, in which the temperature was + 3° C. The galvanometer (Messrs. Elliott's tripod pattern of Thomson's galvanometer), the keys, battery, &c., were carefully insulated by polished ebonite cups. The constant was with 20 small "Thor" dry cells, 8,500 megohms. The sensibility of the instrument could not be increased, since the place was not quiet enough. As I obtained no deflection by the usual method, I had to test by loss of charge. The condenser which I had with me was quite new (Messrs. Muirhead's new pattern of $\frac{1}{3}$rd microfarad capacity, *vide* Kempe, 5th edition, page 288). But to my great astonishment it utterly failed, *i.e.*, it gave a permanent deflection of 30 divisions on the scale when the battery was applied. There was no leakage in the leading wires (highly insulated with India-rubber); for when they were disconnected from the condenser terminals, and laid on the (highly polished) ebonite top, there was no deflection at all. Further trials being useless, I took the two cables to Fort A, and put them during several days in the frozen trench; the testing set was put in a casemate, whose temperature was + 14° C., and testing recommenced. The condenser proved now to be *excellent*; indeed, it lost scarcely $1\frac{1}{4}$ per cent. of its charge in a minute, with the same battery as before.

I had always heard and seen that the insulation resistance of a condenser was better at a low than at a high temperature, so I can find no explanation to this strange phenomenon.

Perhaps you, or one of the numerous cable electricians among your readers, will be kind enough to give information on the subject.

Military Electrician.

Zurich, *May 6th*, 1893.

Railway Train Lighting.

I remember that about 11 years ago Mr. Evelyn-Liardet and another gentleman made some proposals for lighting trains by electricity, and that one of the plans necessitated the laying down of an additional line of rails for the purpose of working the dynamo, and also, so far as I can recollect, the permanent employment of an attendant in the brake van to look after the dynamo. The plans not appearing feasible, were rejected, and I am not aware that we have been working to them; but if Mr. Evelyn-Liardet will point out in what way we have infringed his patent, I shall be very pleased to do what lies in my power to rectify the irregularity.

E. J. Houghton.

Notes on Electro-Tanning.

I note in your issue of the 5th inst. a letter from Mr. Groth, in which he criticises the methods of experiment employed by me, and described in the paper which I read a short time ago before the Institution of Electrical Engineers, on "The Influence of Electricity in Tanning Operations."

In reply to this, I should like to make a few remarks on the following passages, in which Mr. Groth says that some figures, and also some statements I have there made, are "wrong" and "inaccurate."

Mr. Groth says:—"As to the 'final result,' Mr. Falkenstein continues to say: 'It has been established by Messrs. Rideal and Trotter . . . . and Dr. Zerener, that a *saving of time* of from 4 to 38 per cent. is obtained,' which would most likely be understood to mean that Messrs. Rideal and Trotter's working would show 4 per cent., and Dr. Zerener's 38 per cent., whilst, in reality, it should be reversed; but even then the figures are wrong, as they ought to be 83 per cent. . . . ."

The passage in question, as it appears in the Electrical Review, April 21st, page 461, reads as follows:—"The final result has been established by the experiments of Messrs. Rideal and Trotter, Prof. Müntz, of Paris, Dr. Fœlsing, Dr. Zerener, and others, viz., raw hide is capable of combining with its equivalent weight of tannic acid in from 4 per cent. to 38 per cent. (according to the process employed) of the time taken when electricity and mechanical apparatus, or electricity alone, is not applied."

On comparing the two, it will be seen that Mr. Groth has substituted *saving of time* for *time taken*, which entirely alters the sense of the passage; the *time taken* by the several electrical processes, expressed as percentages of the time taken when working in pits without electricity, being obviously quite a different thing from the *saving of time* effected by the use of electricity in any electrical process, compared with the old system. I may add that the 4 per cent. refers to the Worms and Balé process (electricity and mechanical apparatus), and the 38 per cent. to the Laudin and Aborn process (electricity alone), that of Mr. Groth standing at 17 per cent., taking Mr. Groth's value for the *saving of time* in his process as 83 per cent.

Later on in his letter, Mr. Groth accuses me of the use of "statements loosely made," and bases his charge on the above, and also on the following, viz., that in giving an outline of the Worms and Balé process, I did not mention that turpentine was used therein. Now, turpentine is used in that process in small quantities to prevent oxidation and fermentation of the liquors, in the same way that other antiseptics are used in tanning in the pits under the usual system; but its use in that connection in the Worms and Balé process is no more an essential feature of that process than the use of "patent antiseptics" of various kinds is to the process generally employed by tanners in this country."

I think that the above will be sufficient to show that Mr. Groth has possibly been somewhat hasty in reading the paper, and forming his conclusions thereon.

Conrad R. Falkenstein.

London, *May 8th*, 1893.